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DEFENSE TECHNOLOGY FOR ENVIRONMENTAL PROTECTION

Eldon A. Byrd, et al

Naval Ordnance Laboratory

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1 July 1974

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This report presents the status of work completed during the period of June 1973 through June 1974 on Interagency Agreement EPA-IAG-133(D) between the Environmental Protection Agency, National Environmental Research Center, Research Triangle Park, North Carolina, and the Naval Ordnance Laboratory, White Oak, Silver Spring, Maryland. The objective is to identify and assess the extent to which defense technology, residing in

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Department of Defense laboratories and centers, is applicable toward helping meet technological requirements in air pollution monitoring and control, and to initiate specific transfer actions as appropriate. A bibliography of Department of Defense documents relating to air pollution monitoring and control technology is being compiled, and a compendium of Department of Defense laboratory capabilities for those laboratories visited by representatives from the National Environmental Research Center and the Naval Ordnance Laboratory is included. Specific technology transfer actions initiated in this period are also described.

NOLTR 74-174

1 July 1974

DEFENSE TECHNOLOGY FOR ENVIRONMENTAL PROTECTION - INTERIM REPORT

This report contains documentation of progress to date on Task Assignment No. NOL 0830/EPA, sponsored by the Environmental Protection Agency under Interagency Agreement 133(D). The Project Officer for the Environmental Protection Agency is Dr. Dennis C. Drehmel. A final report will be published in July 1975 which will provide complete documentation of information gathered from visits to DOD laboratories, literature searches, and other sources.

The work described in this report is part of the Technology Transfer activity of the Naval Ordnance Laboratory, whereby existing defense technology is adapted toward meeting outstanding requirements in the civilian sector.

ROBERT WILLIAMSON, II
Commander

C. M. SCHOMAN
By direction

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INTRODUCTION

1. There is a growing realization that much of this nation's defense technology base can be adapted and transferred to help meet the many civilian priorities and requirements facing us today. This greater utilization of already-developed defense technology becomes increasingly important in a period of high inflation, where any contribution to producing greater returns from the tax dollar is a step toward a strengthened economy. The adaptation and transfer of existing defense technology to help meet civil sector requirements furthermore makes possible timely technological responses without the necessity of having to rely on wasteful and time-consuming duplication of research and technology development. In many instances, only the catalytic and relatively small effort required to bridge the technology user-source gap is lacking. In recognition of this and the fact that a large portion of the nation's defense technology is found in the system of laboratories and centers maintained by the Department of Defense (DOD) and the Atomic Energy Commission (AEC), the Environmental Protection Agency, National Environmental Research Center, Research Triangle Park, North Carolina (EPA/NERC-RTP) and the Naval Ordnance Laboratory (NOL), White Oak, Silver Spring, Maryland, entered into an interagency agreement to initiate a systematic effort specifically intended to facilitate technology transfer between DOD and AEC laboratories and EPA/NERC-RTP in the air pollution control technology area.

2. The interagency agreement at present consists of the following tasks:

a. Identify and transfer available defense technology applicable to EPA particulate control studies.

b. Design and fabricate a mobile particulate emissions control test facility.

c. Design and fabricate a mobile cyclone test facility. This interim report describes the progress made on Task a. during the period 1 July 1973 to 30 June 1974.

3. The objectives of Task a., above, are to:

a. Identify existing technologies and capabilities in DOD laboratories relating to particulate control.

b. Develop a bibliography of information within DOD which could be applied to particulate control.

c. Assess the feasibility of DOD technology for collecting particulates, especially fine particles.

d. Develop technical-managerial procedures for transfering identified technologies useful to EPA.

e. Transfer from DOD to EPA identified technology applicable to fine particulate control.

Progress toward these objectives has been substantial and is detailed further on page 3 (Progress Summary) of this report.

4. It is realized that the success of the current effort under Task a. is contingent upon the willing cooperation of the different DOD and AEC laboratories and centers. On the whole the interest and cooperation of the numerous facilities visited to date has been exceptional. In fact, the general feeling appears to be more of impatience rather than reluctance to participate in technology transfer activities.

Approach

5. The first effort was to become familiar with EPA-NERC/RTP requirements in air pollution monitoring and control, especially in the area of particulates. A visit was made to RTP for this purpose in September 1973. Once RTP personnel had been interviewed, information on EPA requirements was transmitted by letter to appropriate DOD laboratories (Appendix A). EPA technological requirements were also made available to the DOD laboratories by means of a briefing on the EPA/NERC-RTP organization, programs, and requirements given by Messrs. A. B. Craig, Jim Abbott, and Dr. Dennis Drehmel of EPA to the DOD Technology Transfer Consortium Meeting in San Diego, during 13-16 November 1973. Technology transfer representatives from some thirty DOD laboratories and centers were present at this meeting.

6. To further develop background in air and air-related problems, representatives from NOL have attended EPA sponsored technical meetings including: the 2nd Joint Conference on Sensing Environmental Pollutants, December 1973 (Washington, D.C.), National Oceanographic Institute Center (NOIC), Turbidity Workshop, 6-8 May 1974 (Washington, D.C.), and the National Conference on Municipal Sludge Management, 11-13 June 1974 (Pittsburgh, PA).

7. The technology search effort consists primarily of two major efforts:

a. DOD literature search

(1) Defense Documentation Center

(2) NASA-related

(3) Army, Air Force, and Navy libraries

(4) Miscellaneous other

b. Visits by NOL and EPA representatives to DOD and AEC laboratories

8. Keywords relating to air pollution monitoring and control are input into computer search systems such as DDC. An initial screening reveals tremendous numbers of documents that have air pollution in the title or mentioned in the text. Subsearches are initiated based on the intersection of two or more technologies to retrieve most relevant documents. Similar procedures are in effect for determining water pollution and solid waste disposal impact on air pollution.

9. The selection criteria for visiting a particular laboratory is to make a telephone contact with the technology transfer agent, or directly to a working area if one is not available, to discuss technologies relating to EPA interests that have been developed or might be on-going at the laboratory. If there is sufficient justification, a future visit is planned, based on geographical considerations as well as capability. When several laboratories have been identified for visits in a locale, detailed visit agendas are prepared to help assure efficient use of time at any particular facility. After a few laboratory visits it became apparent that a great deal more in the way of technology was available than had been anticipated. Technological developments in the areas of gaseous pollutants, solid waste disposal, and liquid wastes relating to air pollution were impossible to ignore.

10. Program area managers in EPA headquarters have also been contacted to determine the extent of their interest in water and solid waste technology generated from the literature searches being made. Appropriate key words relating to these additional topical areas were factored into the DDC literature search to ascertain the extent of documented DOD technology relevant to these areas.

11. Coincident with the technology search effort is a continuing assessment of the technology being uncovered relative to EPA requirements. Specific technology transfer actions were initiated in those cases where the technology appeared to present a direct match to known EPA requirements. Specific transfer actions are not limited to "paper" or soft technology, but also include hardware which is physically shipped to EPA.

Progress Summary

12. Appendix B contains a bibliography of documents relating to air pollution monitoring and control uncovered so far. Some have been reviewed and abstracts are provided; others are identified by title only and have not been reviewed. The length of the

bibliography dictates that it will not be possible to review all documents. Only those documents felt to be of major interest are cited even though many others were investigated. The bibliography of over 200 documents contained in this report (estimated to be approximately 50 percent of what will ultimately be discovered) contains many citations of value to EPA in addition to particulate control technology. Bibliographies were also developed for solid waste and liquid pollution but are not included here.

13. The following laboratories have been visited to date by Dr. Dennis C. Drehmel (EPA) and/or Mr. Eldon A. Byrd (NOL):

Date	Laboratory	Location
16 Nov 1973	Naval Undersea Center (NUC)	San Diego, CA
16 Nov 1973	Naval Electronics Lab (NELC)	San Diego, CA
19 Nov 1973	Naval Weapons Center	China Lake, CA
14 Jan 1974	Naval Weapons Lab (NWL)	Dahlgren, VA
15 Jan 1974	Naval Ordnance Lab (NOL)	White Oak, MD
15 Jan 1974	Naval Research Lab (NRL)	Washington, DC
16 Jan 1974	Army Land Warfare Lab (ALWL)	Aberdeen, MD
17 Jan 1974	Army Edgewood Arsenal	Aberdeen, MD
18 Jan 1974	Naval Ship Research & Development Lab	Annapolis, MD
22 Feb 1974	Naval Missile Center (NMC)	Pt. Mugu, CA
25 Feb 1974	Lawrence Berkeley Lab (LBL (AEC) (Byrd only)	Berkeley, CA
27 Feb 1974	Naval Postgraduate School (NPGS) (Byrd only)	Monterey, CA
27-28 Mar 1974	Dugway Proving Grounds (DPG)	Dugway, UT
29 May 1974	Air Force Weapons Lab (AFWL) (Byrd only)	Albuquerque, NM
30 May 1974	Army White Sands Missile Range (Byrd only)	White Sands, NM
31 May 1974	Los Alamos Scientific Lab (LASL) (AEC)	Los Alamos, NM

14. Appendix C outlines the technical capabilities available at each of the laboratories visited. (NOTE: The relative lengths of each laboratory profile has little to do with capability. Some laboratories provided more descriptive material which facilitated preparation of the write-up. The important factors are the types and extent of capabilities.)

15. In the process of developing better communication ties between EPA and the DOD and AEC laboratories, it became apparent that many of the laboratories often are unaware of specific technologies or programs of direct interest and relevance to their activities which are on-going at other laboratories. Consequently, additional benefits are derived from the laboratory visits in that appropriate researchers and managers at the laboratories acquire a better awareness of capabilities and project activities at other laboratories.

16. A specific example of hardware technology transfer occurred after EPA-NERC/RTP personnel at the DOD Technology Transfer Consortium meeting in November 1973 mentioned a need for condensate nuclei counters (CNC's). Preliminary investigations had been initiated by EPA into cost of the equipment. The Naval Air Development Center, Warminster, PA, had such counters available for loan, but they were incompatible with EPA requirements because they operated at 400 Hz. During the visit to the Army's Land Warfare Laboratory in Aberdeen, Maryland, however, it was discovered that 60 Hertz CNC's were available. Steps were immediately taken to transfer two CNC's, a standard, and a particle generator to EPA-NERC/RTP via NOL at no additional cost to EPA. The transfer of this equipment to EPA has been completed successfully. Other such transfers of hardware are in process.

17. The visit to Edgewood Arsenal, Maryland, facilitated the completion of an Interagency Agreement between Edgewood and EPA-NERC/RTP which had been initiated by Edgewood prior to the visit.

18. Also, as a result of literature searching, many references to technology in DOD relating to water and solid waste pollution problems have been discovered. The information is being made available to appropriate EPA personnel at no cost as an additional benefit of this current effort.

Plans for FY 75

19. The goal for FY 75 is to complete the literature search, laboratory visits, and technology transfer actions initiated during the past year. Follow-up in all areas will be necessary, with emphasis on insuring the transfer of identified technology from DOD to EPA.

20. Several recommendations have been made concerning equipment transfers, including one involving an inexpensive particulate

scrubber for automobile exhausts available at the Naval Missile Center, Pt. Mugu, California. Also available at Pt. Mugu is a .55μ uniform particle generator. The procedure to have this device transferred to EPA-NERC/RTP (at no additional cost to EPA) has been initiated and will be completed during FY 75.

21. The following laboratories are currently scheduled for visits:

Date	Laboratory	Location
9 July 1974	Lawrence Livermore Lab (LLL) (AEC)	Livermore, CA
10 July 1974	Lawrence Berkeley Lab (LBL) (AEC)	Berkeley, CA
11 July 1974	McClellan Air Force Base (stack emissions)	Sacramento, CA

Other laboratories that are candidates for visits in FY 75 include:

Laboratory	Location
Air Force Cambridge Research Lab (AFCRL)	Bedford, MA
Rome Air Development Center (RADC)	Griffiss AFB, NY
Navy Undersea Systems Center (NUSC)	Newport, RI
Army Natick Labs	Natick, MA
Army Cold Regions Lab	Hanover, NH
Brookhaven National Lab	Upton, NY
Army Picatinny Arsenal	Dover, NJ
Naval Air Engineering Center (NAEC)	Philadelphia, PA
Naval Air Development Center (NADC)	Warminster, PA
Naval Ship Engineering Center (NSEC)	Philadelphia, PA
Army Electronics Command	Ft. Monmouth, NJ
Navy Coastal Systems Lab (NCSL)	Panama City, FL
Navy Ecology Lab	Jacksonville, FL
Army Tank Command	Warren, MI

Laboratory	Location
Naval Ammunition Depot	Crane, IN
Army Construction Engineering Research Lab	Champaign, IL
Army Rock Island Arsenal	Rock Island, IL
Wright-Patterson Air Force Base	Dayton, OH
Oak Ridge National Lab	Oak Ridge, TN
Argonne National Lab	Argonne, IL
University of Nevada Desert Research Lab	Reno, NV
Edwards AFB Rocket Propulsion Lab	Barstow, CA

22. These laboratories have been contacted and on the basis of technologies of interest to EPA have been identified as candidates for visits. They represent the result of an initial screening of virtually all DOD laboratories. A final determination will be made prior to visiting a laboratory as to the specific technologies they have to offer; therefore this list is subject to change.

APPENDIX A

LETTER TO DOD LABORATORIES

NOLTR 74-174

U.S. NAVAL ORDNANCE LABORATORY
WHITE OAK
SILVER SPRING, MARYLAND 20910

IN REPLY REFER TO:
124:EAB:hb

As a followup to our recent telephone conversation I am forwarding a list of the Environmental Protection Agency (EPA), National Environmental Research Center, Research Triangle Park (NERC-RTP), requirements in air pollution monitoring and control. In general, NERC-RTP is interested in any technology related to the generation and collection of fine particulates (2 microns or less in diameter) and chemical pollutants in the air, including gases and liquids.

The EPA is particularly interested in classified technology that might be divorced from its application for use in the public sector. Technology can run the gamut--from theory to hardware.

Specific NERC-RTP Technology Requirements (most relate to enclosed spaces (chimneys)--not to open air):

Particle size distribution (2 to .01 microns)
Techniques for aerosol generation
Aerosol physics
Particulate sensing and measurement
Mass flow (low velocity)
Flow streams
Automated sensing techniques and instrumentation
Chemical characterization of particles
Microanalysis of particulates from small sample sizes (1/2 to 1 mgm.)
Elemental analysis of collected particles
Measurement techniques for SO_2, SO_4, NO_2, etc.
Turbulence of low velocity gas flows
Volumetric flow
Gaseous and particulate mixtures--sensing and analysis by lasers or other means

124:LAB:hb

Remote analysis of stack gas (analogous with remote analysis of missile plumes)
Precipitators, scrubbers, and filters
New and novel precipitation techniques (e.g., sonic aglomerators)
Fibrous filters (excluding disposable mat-type filters) and their characteristics
Cleanable woven and nonwoven filters
High velocity filtration
High temperature filtration (greater than 550°F)
Fine (less than 2 microns) filtration
High efficiency - high flow filters
Filtration theory and models
Efficiency vs. particle size characterization of filters
Dust characteristics (density, distribution, hardness, etc.)
Dust generation and redispersion

If you feel there is applicable technology available at your laboratory, do not hesitate to call me on 394-1681 (AUTOVON 290-1681), or write me, and I can assist in arranging for EPA to visit your facility.

Sincerely,

E. A. BYRD, Technology
Transfer Office

APPENDIX B

BIBLIOGRAPHY OF DOCUMENTS RELATING TO AIR POLLUTION MONITORING AND CONTROL

Air Pollution Measuring and Monitoring Technology*

1. "Laser Doppler Velocity Measurements of Swirling Flows with Upstream Influence" by Orloff, Kenneth L. and Hartmut, H. B., University of California, Contractor Report No. CR 2284.

   Synopsis: This report is a rather technically oriented report examining swirling flow in a rotating tube and measuring the velocity field in the tube by laser doppler anemometry.

2. "Electron Beam Fluorescence Diagnostics of a Ternary Gas Mixture" by Lewis, J. W. L. and Williams, W. D., Air Force Systems Command, Arnold Air Force Station, Tennessee, Report AEDC TR 7396, July 1973.

   Synopsis: Electron Beam Fluorescence is used for spatially resolving the density of three gases in a flow field. The experimental apparatus and data acquisition in analysis procedures are discussed in the report.

3. "A Laser Atmospheric Pollution Study" by Zeller, E. J., Kansas University, NASA Report NGR-17-002-089, June 1972.

   Synopsis: Discusses Lasers used from spacecraft especially in relation to dust in the atmosphere caused by volcanoes. Also some information concerning aerosols. This is a progress report only five pages in length.

4. "Radiometer Technology Development," Sperry Rand Corporation, Clearwater, Florida, Report Sperry-SNED-SJ-242-7590-2, October 1973.

*Also see "Particle Size Distribution"

5. "Environmental Radiation Monitoring Plan for SM-1A Nuclear Power Plant, Fort Greely, Alaska," Army Engineer Reactors Group, Fort Belvoir, Virginia; May 1971.

Synopsis: The SM-1A environmental radiation monitoring plan provides a systematic method of sample collection, processing, and counting to assure standardized data in sufficient quantity to permit reliable statistical analysis.

6. "Lidar Observatory at White Sands Missile Range," Allen, R. J., Viezee, W.; Stanford Research Institute, Menlo Park, California; DAAB05-69-C-0855; October 1970.

7. "Use of Anisotropic Materials as Chemical Detectors," T. Novak and E. Poziomek, Edgewood Arsenal, in Analytical Letters, 5(3), 187-192 (1972).

8. "Organic Reactions (Detection of Organophosphorus Compounds)," E. Poziomek and E. Crabtree, in Journal of the Association of Official Analytical Chemists, Vol. 56, January 1973.

9. "The Kinetics of Absorption of Organo-Phosphorus Vapors from Air Mixtures by Activated Carbons," L. Jonas and J. Rehrmann, in Carbon, Vol. 10, pp. 657-663, 1972.

10. "Second Joint Conference on Sensing of Environmental Pollutants," Instrument Society of America, Washington, D.C., 10-12 December 1973.

11. "Atmospheric Scattering in the Visible and Infrared," Curcio, J. A., Naval Research Laboratory, Washington, D.C., NRL-5567, January 1961.

12. "Analysis of the Feasibility of an Experiment to Measure Carbon Monoxide in the Atmosphere," Bortner, M. H., General Electric Company, Philadelphia, Pennsylvania, Contract NAS-1-10139, October 1973.

13. "Trace Metal Water Pollutants Determined by X-Ray Fluorescence," Burkhalter, Philip G., Naval Research Laboratory, Washington, D.C., NRL-7637, August 1973.

14. "Simple Method for Measuring Absolute Diffuse Reflectance With a Laboratory Spectrophotometer," Lindberg, James D., Army Electronics Command, White Sands Missile Range, New Mexico, Atmospheric Sciences Laboratory, ECOM-05521, November 1973.

15. "Identification of Traces of Explosives by Field Spot Tests," McDougall, J. L., Simkins, R. J. J., Explosives Research and Development Establishment, Waltham Abbey, England, ERDE-TR-112, March 1973.

16. "Optical Emission Properties of Aircraft Combustible Fluids, Final Report, May 1972 - August 1973," Linford, R. M. F., Dillow, C. F., McDonnell Douglas Corporation, St. Louis, Missouri, McDONNELL-A-2454, Contract F-33615-72-C-1857, August 1973.

17. "X-Ray, an On-Line Program for Automatic Electron Microanalysis of Oxides and Silicates Using a SI-LI-Spectrometer," Gehrke, R. J., Davies, R. C., Aerojet Nuclear Company, Idaho Falls, Idaho, AEROJET-NC-113, March 1974.

18. "Neutron Activation Techniques for the Measurement of Trace Metals in Environmental Samples," Robertson, D. E., Carpenter, R., Pacific Northwest Laboratories, Richland, Washington, NAS-NS-3114, Washington University, Seattle, January 1974.

19. "Nuclear and X-Ray Techniques," W. S. Lyon, Oak Ridge National Laboratory, presented to the "Interagency Conference on the Environment" at Lawrence Livermore Laboratory, Livermore, California, 19 October 1972.

20. "Measurements of Turbulence-Transport Properties with a Laser Doppler Velocimeter," W. Yanta, published as AIAA paper No. 73-169 from the AIAA 11th Aerospace Sciences Meeting, Washington, D.C., January 1973.

21. "Turbulence Measurements with a Laser Doppler Velocimeter," W. Yanta, Naval Ordnance Laboratory, White Oak, Maryland, TR-73-94, 1 May 1973.

22. "Air Pollution Field Studies with a Raman Lidar," H. P. Delong, Defense Systems Division, Directorate of Development and Engineering, Edgewood Arsenal, Aberdeen Proving Ground, Maryland.

23. "Remote Spectroscopic Analysis of Ppm-level Air Pollutants by Raman Spectroscopy," H. and D. Tanenbaum, Edgewood Arsenal, in Applied Physics Letters, Vol. 22, No. 1, 1 January 1973.

24. "Assessment of Stand-off IR Sensor," Army Land Warfare Laboratory, Applied Chemistry Branch, Aberdeen Proving Ground, Maryland, Report F-C3547-06, F-C3538-07, December 1973.

25. "Composition and Concentration Measurements of Atmospheric Pollutants by Remote Probing" by Pekney, W. N., Deseret Test Center, Fort Douglas, Utah, Report No. DTC-TN-72-604, December 1971.

Synopsis: Remote sensing of aerosols using optical radar, mie scattering and Reimann spectroscopy.

26. "Air Borne Aerosol Measurements Associated with Clear Air Turbulence Progress Report," Rosen, J. M.; Wyoming University, Laramie; NGR-51-001-028, September 1972.

27. "Measurement of Atmospheric Particles and Laboratory Experiments on the Adsorption and Oxidation of Sulfur Dioxide on the Surface of Particles at Room Temperature," Okita, T.; Army Foreign Science and Technology Center, Charlottesville, Virginia, FSTC-HT-23-101-71, July 1971.

28. "Survey of Electrostatic Probe Theories, May 1970 - September 1970," Fedele, J., Aerospace Corporation, San Bernadino, California, AEROSPACE-TR-0059-S-6816-42-01, Contract No. F-04701-70-C-0059, November 1970.

29. "Unique Method for Monitoring Cabin Air Pollution from Engine Oil in the EB57D Aircraft, Final Report, September 1968 - July 1970," Crawford, William J., Wells, Henry A., Air Force Materials Laboratory, Wright-Patterson Air Force Base, Ohio, AFML-IR-72-244, May 1973.

30. "Survey of Methods of Observation and Measurement of Atmospheric Pollution," D. Mason, ONR London Conference Report C-27-73, 31 December 1973.

31. "Laser Beam Behavior On a Long High Path," Mason, J. B. and Lindberg, J. D., R&D Technical Report ECOM-5430, April 1973.

32. "Visible and Near Infrared Absorption Coefficients of Kaolinite and Related Clays," Lindberg, James D. and Smith, Michael S., Atmospheric Sciences Laboratory, R&D Technical Report ECOM-5522, November 1973.

33. "Diffuse Reflectance Spectra of Several Clay Minerals," Lindberg, James D. and Snyder, David G., Atmospheric Sciences Laboratory, American Mineralogist, Vol. 57, pp. 485-493, 1972.

34. "Reflectance Spectra of Gypsum Sand from the White Sands National Monument and Basalt from a Nearby Lava Flow," Lindberg, James D. and Smith, Michael S., Atmospheric Sciences Laboratory, American Mineralogist, Vol. 58, pp. 1062-1064, 1973.

35. "Measuring the Transmittance of Atmospheric Dust in KBr Pellets Using a CO_2 Laser," White, Kenneth O. and Lindberg, James D., Applied Optics, Vol. 12, No. 11, November 1973.

36. "Determination of the Optical Absorption Coefficient of Powdered Materials Whose Particle Size Distribution and Refraction Indices are Unknown," Lindberg, James D. and Snyder, David G., Applied Optics, Vol 12, p. 573, March 1973.

37. "A Measurement of the Absorption Coefficient of Atmospheric Dust," Lindberg, James D. and Laude, Larry S., Atmospheric Sciences Laboratory, R&D Technical Report ECOM-5525, December 1973.

38. "Stratospheric Balloon Aerosol Particle Counter Measurements, Final Report, February 1973 - November 1973," Miranda, Henry A., Jr., Epsilon Laboratories, Inc., Bedford, Massachusetts, EPSILON-FR-2001-73, AFCRL-73-0700, Contract F-19628-73-C-0138, November 1973.

39. "Detection Techniques for Air Pollutants," Edgewood Arsenal, SMUEA-TD, March 1972.

40. "Effluent Plume Imagining," Westinghouse Electric Corporation, LWL-CR-02C72, March 1973.

41. "Assessment of Stand-Off IR Sensor," Franklin Institute, DAAD05-73-C0140, December 1973.

42. "IRIA Annotated Bibliography of Infrared Literature," Vol. 16, Nos. 1 and 2, Environmental Research Institute of Michigan, Ann Arbor, Contract N-00014-73-A-0321, ERIM-102400-1-8, July 1973.

43. "Environmental Instrumentation Conference," USAMC, EASP 1800-5, July 1972.

44. "Proceedings of 1st - 4th Annual Symposium on Environmental Pollution," American Ordnance Association, EASP 100-78, 100-102, 1300-3, 1800-16, February 1972, August 1971, August 1973, September 1973.

45. "Elemental Analysis of Air Filter Samples Using X-Ray Fluorescence" by Bonner, N. A., et al, Lawrence Livermore Laboratory, Report UCRL 51388, 1 June 1973.

Synopsis: This report examines a silicone lithium detector and computer used for the analysis of air filter samples. The system is capable of making measurements on all elements heavier than phosphorus in a qualitative way and in a quantitative way on all elements heavier than potassium. The three sigma detection limits range from 10 to 100 nanograms per square centimeter. Methods described required no sample preparation and are nondestructive. Quantitative information from such a system as described in this report can be useful in monitoring trace element concentrations in the air.

Pollution Control Technology

1. "Aerosol Filtration by Fibrous Filter Mats," W. Magee, et al, Edgewood Arsenal, in Environmental Science and Technology, Vol. 7, pp. 1131-1135, December 1973.

2. "Efficiency of IPC-1478 Filter Paper Against Polystyrene Latex and DOP Aerosols" by R. Stafford and H. Ettinger, in American Industrial Hygiene Association Journal, Vol. 32, No. 8, August 1971.

3. "Liquid Film Smoke Scrubber: A Feasibility Study" by Fu, P. T., Naval Civil Engineering Laboratory, Port Hueneme, California, Report No. TN 1268, February 1973.

   Synopsis: This report concerns primarily a description of a smoke scrubber from jet engine fuel combustion. It also includes technology related to dynamics of gases, electrostatics, smoke abatement and aerosols.

4. "The Mechanisms and Kinetics of Aerosol Filtration," Jones, S. P., et al, Cambridge Technology Inc., Newton Upper Falls, Massachusetts, Report 5016-1, July 1968.

   Synopsis: Particle diffusion, aerosols, fiber and fluid filters and aerodynamic characteristics were discussed in this report.

5. "Quantitative Evaluation of Smoke Abatement System for Crash-Rescue Training Fires," Haney, James T. and Ristau, William T., New Mexico University Albuquerque, Eric H. Wang Civil Engineering Research Facility, TR-73-106, May 1973.

   Synopsis: The training of Air Force firefighting personnel involves the extinguishing of large fires that simulate aircraft crash situations. Such fires generate clouds of thick black smoke that are objectionable from an air pollution viewpoint and, therefore, cannot be continued on the present basis. This report outlines the quantitative evaluation of the water spray injection smoke abatement system for the training fires. Basic design criteria have been established for the smoke abatement systems and emission factors in terms of pounds of particulates per 1000 pounds of fuel were determined for JP-4 fires.

6. "Propellant Disposal Facility Phase I," Bewley, F. W., Naval Ordnance Station, Indian Head, Maryland, Report No. NOS-IHMR-72-185, June 1972.

Synopsis: The data for the design of a propellant disposal facility are summarized. The complete disposal system, including size reduction and effluent treatment, is discussed with regard to the available types, economics, safety, and resulting pollutants. The proposed facility is described.

7. "Air Pollution Engineering Source Sampling Survey, Red Water Incinerator, Volunteer Army Ammunition Plant, Tyner, Tennessee, 24-31 July 1968," Burke, Roy C., III, Army Environmental Hygiene Agency, Edgewood Arsenal, Maryland, USAEHA-Survey-21-30-68/69, October 1968.

Synopsis: A source sampling survey was conducted for the period 24-31 July 1968, at the Red Water Incinerator, Volunteer Army Ammunition Plant. The installed scrubbers complied with performance criteria outlined in contract specifications.

8. "Proceedings of Annual Symposium on Environmental Pollution (4th), Held at Edgewood Arsenal, Aberdeen Proving Ground, Maryland, on 4-5 April 1973, Sponsored by the American Ordnance Association," Hilsmeier, Allen E.; Edgewood Arsenal, Aberdeen Proving Ground, Maryland, EA-SP-1800-16, September 1973.

Synopsis: Contents include: environmental protection; hazardous materials control programs in the Department of Defense; Department of Defense research and development in hazardous material disposal; Naval ordnance RDTE program on pollution abatement; pollution control from explosive production waste streams; prevention and control of hazardous material spills; advances in reclamation technology by high-temperature incineration; national disposal sites for hazardous wastes; environmental control in rocket propulsion research; pesticide waste disposal; nuclear waste disposal; use of salt repositories for long-term retention of hazardous waste material; the Edgewood Arsenal role in environmental technology.

9. "Holston Army Ammunition Plant: Pollution and Abatement Plans," Heidelberger, William, Picatinny Arsenal, Dover, New Jersey; PA-TR-4286, November 1971.

Synopsis: The report discusses the environmental pollution problem and abatement plans associated with the manufacturing of munitions at the Holston Army Ammunition Plant, Kingsport, Tennessee.

10. "Engineering Analysis," Neal, L. G., TRW Inc., Redondo Beach, California, TRW-96020.007, August 1973.

Synopsis: An in-depth survey and analysis of pollution problems at government-owned contractor-operated Army Ammunition Plants (AAP) has been conducted. The basis of the study was government furnished data describing pollution problems and abatement actions which was collected by Picatinny Arsenal. The data was obtained from the plant operators, and the files of Frankford, Edgewood, and Picatinny Arsenals.

11. "Overview Report of Pollution Abatement Project," Neal, L. G., Report No. TRW-96020.006, January 1973.

Synopsis: A systematic analysis of the pollution problems at Army Ammunition Plants (AAP) and the related manufacturing methods and technology (MM and T) pollution abatement project was performed. The MM and T pollution abatement project provides an integrated plan of action for pollution control at the AAP's. The pollution problems at the AAP's were analyzed, available pollution control technology determined, and the MM and T pollution abatement project reviewed to determine its adequacy to provide new technology required. Recommendations for future courses of action were also made.

12. "Investigation of the Effectiveness of Cyclone Separators on Fluidic Power Supplies, Final Report," Westerman, W. J., Jr., McDonnell Douglas Astronautics Company, Titusville, Florida, McDONNELL-L-0243, Contract DAAG-39-73-C-0100, December 1973.

13. "Pyrotechnic Exploratory Development and Pollution Abatement, Semi-Annual Report, November 1973 - February 1974," Douda, Bernard F., Naval Ammunition Depot, Crane, Indiana, Research and Development Department, NAD-RDTR-248, February 1974.

14. "Pollution Abatement, Reclamation of Red Phosphorus Smoke Composition, Final Report, September 1972 - April 1974," Johnson, Duane M. and Gilliam, Clarence W., Naval Ammunition Depot, Crane, Indiana, NAD-RDTR-267, April 1974.

15. "Optimal Control of Sulfur Dioxide Emissions at Power Stations, Models and a Case Study," Patel, Nitin R., Massachusetts Institute of Technology, Cambridge, Operations Research Center, Contract DAHC-04-73-C-0032, Thesis, September 1973.

16. "Fixed and Fluidized Beds: An Introduction," Pallay, Barry G., Naval Ordnance Laboratory, NOLTR 73-54, December 1973.

17. "Evaluation of Emission Control Strategies for Sulfur Dioxide and Particulates in the St. Louis Metropolitan Air Quality Control Region," Argonne National Laboratory, IIPP-5, October 1971.

18. "CONE: Control of Noxious Effluents, December 1972" by Don Silva, Air Force Weapons Laboratory AFWL-DE-TN-73-029, November 1973.

19. "2nd - 6th Annual Progress Report: Status of Chemical Research in Atmosphere Purification and Control on Nuclear Powered Submarines," Naval Research Laboratory, 5814, 6053, 6251, 6491, 6722, August 1962, December 1963, March 1965, January 1967, June 1968.

20. "Progress Report on Chemical Research in Nuclear Submarine Atmosphere Purification," Naval Research Laboratory, 7037, June 1970.

21. "Naval Recycling Procedures as an Air to Pollution Abatement" by Kanitz, Thomas C., Navy Manpower and Material Analysis Center, Atlantic, Report No. NAVMMACLANT-89, May 1973.

Synopsis: Although primarily involved with solid waste disposal, a portion of this report has to do with steam power plants and air pollution. The primary purpose of the study was to deal with problems of waste disposal as they exist and to prevent their recurrence.

22. "Joliet Army Ammunition Plant Pollution Discussion and Abatement Plans" by Griffin, Donald F., Picatinny Arsenal, Dover, New Jersey, Report PA-TR-4368, June 1972.

Synopsis: This report is concerned with the pollution problems resulting from operations conducted at the Joliet Army Ammunition Plant. These include exhaust gases.

23. "Relations Between the Mass and Numerical Concentrations of Atmospheric Aerosol Particles" by Meszaros, A. N., Army Foreign Science and Technology Center, Charlottesville, Virginia, Translation Report FSTC-HT-23-099-71, March 1971.

Synopsis: This short document covers information concerning aerosols and fluid filters and particle size distribution.

24. "The Measurement of Particle Sizes and their Distribution in the Condensation Nuclei Counter," Cole, C. J., et al, Cambridge Technology, Inc., Newton Upper Falls, Massachusetts, Report 5023-2, November 1969.

Synopsis: Report covers aerosols, sampling, electrostatic precipitators, and particle size distributions.

25. "Studies in Air Sampling and Purification by Space Charged Precipitation" by Forsyth, R. H., et al, Cambridge Technology, Inc., Newton Upper Falls, Massachusetts, Report 5021-4, October 1970.

Synopsis: This report covers technology concerned with electrostatic precipitators and aerosols among other air purification techniques and air sampling techniques.

Aerosols (General)

1. "Aerosol Systems Study Program (U)" by Ritland, H. N. and Thacker, G. H., Space and Missile Systems Organization (SAMSO) Report TR 72-12, May 1972, SECRET.

2. "Design Analysis of an Air Force Environmental Pollution Field Laboratory" by Carlton, H. E., et al, Air Force Weapons Laboratory Report TR 73-103, June 1973.

   Synopsis: This report contains Air Force requirements for Mobile Field Laboratories involved with air pollution and water pollution. Although not a major portion of the report, part of it does deal with pollution and stack gases.

3. "Relations Between the Mass and Numerical Concentrations of Atmospheric Aerosol Particles" by Meszaros, A. N., Army Foreign Science and Technology Center, Charlottesville, Virginia, Translation Report FSTC-HT-23-[illegible]9-71, March 1971.

   Synopsis: This short document covers information concerning aerosols and fluid filters and particle size distribution.

4. "Aerosol Dissemination Assessment," Lilienfeld, P., Geophysics Corporation of America, Bedford, Massachusetts, GCA-TR-68-3-G, March 1968.

5. "Feasibility Determination for Development of a Physical Mathematical Model of Particle/Atmosphere Dynamics," Baroff, J. H., et al, Edgewood Arsenal, Maryland, December 1967.

   Synopsis: This report describes a physical mathematical model for simulation of aerosol cloud behavior, including equations of motion, particle size distribution and a computer simulation.

6. "The Attenuation of Visible and Infrared Radiation by Artificial Aerosols and Their Effect Upon Visibility," Kulb, W., Army Foreign Science and Technology Center, Charlottesville, Virginia, FSTC-HT-23-097-71, 1971.

7. "A Laser Atmospheric Pollution Study," Zeller, E. J., Kansas University, Lawrence, NGR-17-002-089, June 1972.

Aerosols/Particulates: Particle Size Distribution

1. "Steady State Aerosols" by Storeboer, P. B., Norwegian Defense Research Establishment, Report NDRE-60, February 1972.

   Synopsis: Report covers particle size distribution and aerosols. Also some on particle production.

2. "Particle Size Distribution in the Air," Douglas Aircraft Company, Santa Monica, California, Report No. DAC-SM42667, January 1963.

   Synopsis: This report is in at least 17 parts. The first part is a 20-page summary, the 16th part is a rather bulky document covering particle size distribution with lots of data. Part 5 covers particle size distributions and is concerned mainly with the Flagstaff, Arizona area whereas Part 16 covered the Denver area; Part 15 the Chicago area; Part 13 the Fort Detrick area; Part 17 the San Francisco area; Part 12 the Hunter-Liggett area; and Part 6 the Dallas area.

3. "The Measurement of Particle Sizes and their Distribution in the Condensation Nuclei Counter," Cole, C. J., et al, Cambridge Technology, Inc., Newton Upper Falls, Massachusetts, Report 5023-2, November 1969.

   Synopsis: Report covers aerosols, sampling, electrostatic precipitators, and particle size distributions.

4. "The Distribution of Small Particulates Which Act As Condensation and Freezing Nuclei, Final Report," Henderson, T. J., Atmospherics, Inc., Fresno, California, NWC-TP-4781, September 1969.

5. "Plutonium Aerosol Size Characteristics," J. Elder, et al, Los Alamos Scientific Laboratory, LA-UR73-1326, 1973.

6. "Effect of Particle Size on the Carrier Distillation Analysis of PuO_2," Martell, Calvin J., Los Alamos Scientific Laboratory, New Mexico, LA-5454, February 1974.

7. "Fiber Optics Particle-Sizing System," Bentley, H. T., Aro, Inc., Arnold Engineering Development Center, AEDC-TR-73-111, September 1973.

8. "Post Stabilization Nuclear Dust Cloud, Nuclear Dust Cloud Mass Density Plots by Particle Size Class, Final Report, November 1972 - April 1973, Vol. 03," Trentacoste, Nicholas P., Science Applications, Inc., Arlington, Virginia; Contract DNA-001-72-C-0082, August 1973.

9. "Relations Between the Mass and Numerical Concentrations of Atmospheric Aerosol Particles" by Meszaros, A. N., Army Foreign Science and Technology Center, Charlottesville, Virginia, Translation Report FSTC-HT-23-099-71, March 1971.

Synopsis: This short document covers information concerning aerosols and fluid filters and particle size distribution.

10. "Feasibility Determination for Development of a Physical Mathematical Model of Particle/Atmosphere Dynamics," Baroff, J. H., et al, Edgewood Arsenal, Maryland, December 1967.

Synopsis: This report describes a physical mathematical model for simulation of aerosol cloud behavior, including equations of motion, particles size distribution and a computer simulation.

11. "Characterization of the Naturally Occurring Particulates in the Marine Atmosphere, Trial One Data Summary," Hereim, A. T. and Harris, G. J., Deseret Test Center, Fort Douglas, Utah, DTC-DR-70-00C, January 1973.

12. "Three Dimensional Characterization of Particles in Alumina Powders by Automated Sem Analysis," Tarhay, L., Pennsylvania State University, University Park. Materials Research Laboratory, Contract N-00014-67-A-0385, February 1974.

13. "Characterizations of the Naturally Occurring Particles in the Marine Atmosphere" by Hereim, A. T. and Harris G. J., Deseret Test Center, Fort Douglas, Utah, Report DTC-DR-70-00C, January 1973.

Synopsis: Report covers test equipment air sampling in California and particle size distribution.

14. "Studies on the Use of a Novem Aerosolization Device for Collecting and Sizing Particles in the Ambient Atmosphere," Dews, J. N. and Stefanye, D., Fort Detrick, Frederick, Maryland TM-117, August 1969.

Aerosols/Particle Generation

1. "Effects of Artificial Aerosols; Methods of Synthesis and Analysis of Submicron Aerosols," Goetz, A. and Kallai, T., Army Biological Laboratory, Fort Detrick, Maryland, Translation 789, May 1963.

Synopsis: This short report concerns aerosols, hydrocarbons and quantitative analysis of air pollution.

2. "Fiber Optics Particle Sizing System," Bently, H. T., Arnold Engineering Development Center, Arnold Air Force Station, Tennessee, Report AEDC TR-73-111, September 1973.

3. "Powder Trail Generator for Visual Sighting of Target Drones," Werle, D., IIT Research Institute, Chicago, Illinois, Contract N-00123-72-C-0235, 1972.

4. "Steady State Aerosols" by Storeboer, P. B., Norwegian Defense Research Establishment, Report NDRE-60, February 1972.

Synopsis: Report covers particle size distribution and aerosols. Also some on particle production.

Particulates (General)

1. "The Mechanisms of Fallout Particle Formation, Annual Progress Report for period ending June 1971," by Benck, Ralph A., et al, United States Army Ballistic Research Laboratories, Aberdeen Proving Ground, Maryland, Report No. BRLMR2304.

   Synopsis: Emphasis in this report is on understanding the nucleation or condensation of gaseous product elements into various solid substrates. Results obtained are useful in making general predictions regarding condensation behavior on oxide and metal substrates.

2. "Feasibility Determination for Development of a Physical-Mathematical Model of Particle/Atmosphere Dynamics Final Report, April - October 1967," Baroff, J. H., Childers, H. M., and Stone, D. E., Vertex Corporation, Kensington, Maryland, DAAA15-67-0469, December 1967.

3. "The Annual Variation of the Concentration of Chloride Particles in the Air," Meszaro, E., Army Foreign Science and Technology Center, Charlottesville, Virginia, FSTC-HT-23-095-71, July 1971.

4. "Characterization of the Naturally Occurring Particulates in the Marine Atmosphere, Trial One Data Summary," Hereim, A. T. and Harris, G. J., Deseret Test Center, Fort Douglas, Utah, DTC-DR-70-00C, January 1973.

5. "Estimates of the Extinction of Electromagnetic Energy in the 8 to 12 μm Range by Natural Atmospheric Particulate Matter," Lentz, W. J. and Hoidale, G. B., Atmospheric Sciences Laboratory, R&D Technical Report ECOM-5528, January 1974.

6. "Three Dimensional Characterization of Particles in Alumina Powders by Automated Sem Analysis," Tarhay, L., Pennsylvania State University, University Park, Materials Research Laboratory, Contract N-00014-67-A-0385, February 1974.

7. "Air Pollution Engineering, Radford Army Ammunition Plant, Radford, Virginia, 13 July - 26 August 1969," Davis, Mackenzie L., Army Environmental Hygiene Agency, Edgewood Arsenal, Maryland, USAEHA-Survey-21-026-69/70, November 1969.

Synopsis: An atmospheric sampling survey was conducted at Radford Army Ammunition Plant to evaluate air pollutant concentrations with respect to existing and anticipated standards. Suspended particulates, sulfur dioxide, and nitrogen dioxide were measured at seven locations on and around the plant property.

Meteorology

1. "Prediction of Mesoscale Flows Over Complex Terrain," Anthes, Richard A. and Warner, Thomas T., Army Electronics Command, White Sands Atmospheric Sciences Laboratory, ECOM-05532, March 1974.

2. "Relation Between the Concentration of the Aerosol Particles and Weather Conditions," Meszaros, A., Army Foreign Science and Technology Center, Charlottesville, Virginia, FTSC-HT-23-090-71, April 1971.

3. "Microphysical and Meteorological Measurements of Fog Supersaturation," Low, Richard D. H., Army Electronics Command, White Sands Missile Range, New Mexico, Atmospheric Sciences Laboratory, ECOM-05526, December 1973.

4. "Microphysical Evolution of Fog," Low, Richard D. H., Army Electronics Command, White Sands Missile Range, New Mexico, Atmospheric Sciences Laboratory, ECOM-05533, March 1974.

5. "Condensation Nuclei and Aerosol Populations Related to Fog Formation, Final Report 02, June 1967 - December 1973," Ludwig, Francis L., Stanford Research Institute, Menlo Park, California, Contract DAHC-04-67-C-0059, January 1974.

6. "Studies of Atmospheric Processes, Semiannual Report 03," Fisher, Edward R., Wayne State University, Detroit, Michigan, Research Institute for Engineering Sciences, Contract F-19628-72-C-0007, December 1972.

7. "Thermal Warm Fog Dissipation, Heat Requirements and Projected Utilization of a System for Travis Air Force Base, California," Weinstein, Alan I., Air Force Cambridge Research Laboratories, L. G. Hamscom Field, Massachusetts, AFCRL-73-0367, June 1973.

8. "Environmental Pattern Reconstruction From Sample Data, a Case Study and Some General Conclusions, Final Report," McCammon, Richard B., Illinois University, Chicago, Contract N-00014-69-A-0090, September 1973.

9. "Analytical Model of Multiple Cloud Phenomenology, Final Report, November 1972 - July 1973," Hains, Frank D., Science Applications, Inc., Arlington, Virginia, Contract DNA-001-73-C-0054, SAI-73-211-AR, October 1973.

10. "Structure and Modification of Clouds and Fogs, Final Report, September 1967 - September 1973," Vonnegut, Bernard, State University of New York, Albany, Contract F-19628-68-C-0057, Project Themis, September 1973.

11. "Analysis of Random Fluctuations of Atmospheric Dust Concentrations," Henley, David C., Army Electronics Command, White Sands Missile Range, New Mexico, Atmospheric Sciences Laboratory, ECOM-05530, January 1974.

12. "Atmospheric Effects Long Range Planning, Minutes of Meeting, Proceedings, 16 January 1973 - 17 January 1973," Defense Nuclear Agency, Washington, D.C., DNA-3171-P, October 1973.

13. "Nucleation Activity of Organic Cloud Seeding Agents," Fletcher, Aaron N., Naval Weapons Center, China Lake, California, NWC-TP-5592, December 1973.

14. "Abbreviated Tables of Thermodynamic Properties to 85 KM for the U. S. Standard Atmosphere, 1974," Kantor, Arthur J. and Cole, Allen E., Air Force Cambridge Research Laboratories, L. G. Hanscom Field, Massachusetts, AFCRL-73-0687, November 1973.

15. "Specific Ionization in the Polar Atmosphere Due to Precipitating Heavy Particles," Kelley,,Joseph G. and Sellers, Bach, Air Force Cambridge Research Laboratories, L. G. Hanscom Field, Massachusetts, AFCRL-73-0672, November 1973.

16. "Modeling the Chemical Kinetics of the Stratosphere," Hudson, Frank P., Sandia Laboratories, Albuquerque, New Mexico, SL-TM-72-0716, June 1973.

17. "Atmospheric Effects, Bibliography," Warner, Evelyn L., General Electric Company, Santa Barbara, California, DASIAC/DOD, Nuclear Information and Analysis Center, DASIAC-B-AE-73-01, Contract DNA-001-73-C-0019, July 1973.

18. "DNA 1973 Atmospheric Effects Symposium, Proceedings, Vol. 02," Defense Nuclear Agency, Washington, D.C., DNA-3131-P-2, June 1973.

19. "Air Pollution Engineering Source and Ambient Sampling Survey" by Clearwater, R. M., et al, Army Environmental Hygiene Agency, Edgewood Arsenal, Maryland, Report USA EHA-21-032-71/72, September 1972.

Synopsis: Wind effects on sulphur oxides, particles and lead.

Pesticides

1. "Gas-Liquid Chromatographic Analysis of Some Pesticides in Lake Water, Mud, and Soil," Sass, Samuel, et al, Edgewood Arsenal, Maryland, EA-TR-4389, April 1970.

   Synopsis: A continuous extraction procedure, employing liquid-liquid partitioning, allows the separation and concentration of pesticides such that parts-per-billion, and even lower quantities of materials, can be determined in samples of various environmental media. The method employs gas-liquid chromatography coupled with an electron-capture detector for quantitation. Chlorinated pesticides, such as Aldrin, Dieldrin, and Endrin can be readily detected at the L-NG level whereas phosphorus pesticides, such as parathion and methyl parathion, are detectable at the 7.5-NG level. The applicability of the described method has also been established for a variety of other pesticides.

2. "Proceedings of Meeting on Environmental Pollution (2nd) 24-25 March 1971," Sponsored by American Ordnance Association, Love, Solomon, Edgewood Arsenal, Maryland, EA-SP-100-102, August 1971.

   Synopsis: The titles of the reports presented include: Handling and Incineration of Pesticides, Plastics, and Hazardous Chemicals; Advanced Fluid Bed Incinerator.

3. "Proceedings of Annual Symposium on Environmental Pollution (4th), Held at Edgewood Arsenal, Aberdeen Proving Ground, Maryland, on 4-5 April 1973, Sponsored by the American Ordnance Association," Hilsmeier, Allen E.; Edgewood Arsenal, Aberdeen Proving Ground, Maryland, EA-SP-1800-16, September 1973.

   Synopsis: Contents include: environmental protection; hazardous materials control programs in the Department of Defense; Department of Defense research and development in hazardous material disposal; Naval ordnance RDTE program on pollution abatement; pollution control from explosive production waste streams; prevention and control of hazardous material spills; advances in reclamation technology by high-temperature incineration; national disposal sites for hazardous wastes; environmental control in rocket propulsion research; pesticide waste disposal; nuclear waste disposal; use of salt repositories for long-term retention of hazardous waste material; the Edgewood Arsenal role in environmental technology.

Sampling

1. "Elemental Analysis of Air Filter Samples Using X-Ray Fluorescence" by Bonner, N. A., et al, Lawrence Livermore Laboratory, Report UCRL 51388, 1 June 1973.

   Synopsis: This report examines a silicone lithium detector and computer used for the analysis of air filter samples. The system is capable of making measurements on all elements heavier than phosphorus in a qualitative way and in a quantitative way on all elements heavier than potassium. The three sigma detection limits range from 10 to 100 nanograms per square centimeter. Methods described required no sample preparation and are nondestructive. Quantitative information from such a system as described in this report can be useful in monitoring trace element concentrations in the air.

2. "Characterizations of the Naturally Occurring Particles in the Marine Atmosphere" by Hereim, A. T. and Harris G. J., Deseret Test Center, Fort Douglas, Utah, Report DTC-DR-70-00C, January 1973.

   Synopsis: Report covers test equipment air sampling in California and particle size distribution.

3. "Air Pollution Engineering Source and Ambient Sampling Survey" by Clearwater, R. M., et al, Army Environmental Hygiene Agency, Edgewood Arsenal, Maryland, Report USA EHA-21-032-71/72. September 1972.

   Synopsis: Wind effects on sulphur oxides, particles and lead.

4. "Studies in Air Sampling and Purification by Space Charged Precipitation" by Forsyth, R. H., et al, Cambridge Technology, Inc., Newton Upper Falls, Massachusetts, Report 5021-4, October 1970.

   Synopsis: This report covers technology concerned with electrostatic precipitators and aerosols among other air purification techniques and air sampling techniques.

5. "Air Pollution Resulting from Distillate Fuel Combustion," Gorin, N. H. and Dixon, E., Naval Ship Engineering Center, Philadelphia, Pennsylvania, Report No. NAVSECPHILADIV-A-1327, October 1972.

Synopsis: A Source Emission Monitor (SEM) was constructed for measuring gaseous emission products of Navy distillate (ND) combustion in the flue gas of Naval test steam generators. The products studied were smoke, S02, NO(X), CO, HC, CO2 and 02. The instrumentation was transportable and designed to collect air pollution data from four steam generators at various locations. Three of the four units monitored were not steamed specifically for air pollution purposes, but were simultaneously examined during other test programs proceeding with the air pollution studies.

6. "Air Pollution Engineering, Radford Army Ammunition Plant, Radford, Virginia, 13 July - 26 August 1969," Davis, MacKenzie L., Army Environmental Hygiene Agency, Edgewood Arsenal, Maryland, USAEHA-Survey-21-026-69/70, November 1969.

Synopsis: An atmospheric sampling survey was conducted at Radford Army Ammunition Plant to evaluate air pollutant concentrations with respect to existing and anticipated standards. Suspended particulates, sulfur dioxide, and nitrogen dioxide were measured at seven locations on and around the plant property.

7. "Sunflower Army Ammunition Plant, Lawrence, Kansas, 4-16 December 1967," Kasline, Thomas F., Army Environmental Hygiene Agency Edgewood Arsenal, Maryland, Report No. USAEHA-Survey-21-12-68/69, September 1968.

Synopsis: An air pollution source sampling survey was conducted at Sunflower Army Ammunition Plant, to determine the concentration of gaseous mist, and particulate emissions from the powerhouse and chemical manufacturing operations. (Reports similar to this covering other Army installations are available including: Fort Riley, Fort Riley, Kansas; Tobyhanna Army Depot, Tobyhanna, Pennsylvania; Volunteer Army Ammunition Plant, Tyner, Tennessee; Weldon Spring Chemical Plant, Weldon Spring, Missouri; Fort Leonard Wood, Fort Leonard Wood, Missouri; Valley Forge General Hospital, Phoenixville, Pennsylvania; Fort Myer, Fort Myer, Virginia; Military Ocean Terminal, Bayonne, New Jersey; Frankford Arsenal, Philadelphia, Pennsylvania; Seneca Army Depot, Romulus, New York; Fort Monmouth, Fort Monmouth, New Jersey; Natick Laboratories, Natick, Massachusetts; Detroit Arsenal, Warren, Michigan; Fort Benjamin Harrison, Fort Benjamin Harrison, Indiana; Fort George G. Meade, Fort George G. Meade, Maryland; Fort Sam Houston, Fort Sam Houston, Texas; Aeronautical Depot Maintenance Center, Corpus Christi, Texas; Army Materials and Mechanics Research Center, Watertown, Massachusetts; Fort Lawton, Fort Lawton, Washington; Jefferson Proving Ground, Madison, Indiana; Fort Hamilton Command, Fort Hamilton, New York; Madigan General Hospital, Tacoma, Washington; Badger Army Ammunition Plant, Baraboo, Wisconsin; Fort Polk, Louisiana; and Military Ocean Terminal, Sunny Point, Southport, North Carolina.

8. "Studies on the Use of a Novem Aerosolization Device for Collecting and Sizing Particles in the Ambient Atmosphere," Dews, J. N. and Stefanye, D., Fort Detrick, Frederick, Maryland, TM-177, August 1969.

9. "Exploratory Development of Continuous Filament Rotary Impactor Systems Final Report, February 1967 - January 1968," Green, W. D., Le Blanc, E. R., and Steck, C. H., Meteorology Research Inc., Altadena, California, MRI-68-FR-836, April 1969.

10. "Investigation of an Inertial Air Sampler Final Report," Rees, L. W. and Vomela, R. A., Environmental Research Corporation, St. Paul, Minnesota, REPT-802, September 1968.

11. "Study of Aerodynamic Rotors for Air Sampling, Final Summary Report, 11 June 1969 - 26 July 1970," Elwell, R. B., Aerojet-General Corporation, Fullerton, California, AGC-5078-01/01/FP, August 1970.

12. "Study of Aerodynamic Rotors for Air Samples," Elwell, R. B., Aerojet-General Corporation, Fullerton, California, AGC-5078-01/01/QP, November 1969.

13. "Air Pollution Engineering Source and Ambient Sampling Survey No. 21-032-71/72, Holston Army Ammunition Plant, Kingsport, Tennessee," Clearwater, R. M., Regan, G. F., and Leininger, K. V., Army Environmental Hygiene Agency, Edgewood Arsenal, Maryland, USAEHA-21-032-71/72, September 1972.

14. "Calibration of Two Stage Air Samplers," H. Ettinger, et al, in American Industrial Hygiene Association Journal, Vol. 31, September - October 1970.

15. "Evaluation of the ERC Virtual Impactor," Loo, Billy W. and Jaklevic, Joseph M., University of California (Berkeley), Lawrence Berkeley Laboratory, California Univ-LBL-2468, January 1974.

16. "Use of Whatman - 41 Filters in Air Quality Sampling Networks," H. Neustadter, et al, NASA TND-7595, May 1974.

17. "Stack Monitor System at the Idaho Chemical Processing Plant," Girton, R. C., Allied Chemical Corporation, Idaho Falls, Idaho, ICP-1034, September 1973.

18. "Sampling of Emission Products from Ship's Boiler Stacks," NSRDC 28-169, April 1972.

19. "A Study of Stack Emissions from Coast Guard Cutters," Scott Research Laboratories, CG-D-13-73, September 1973.

20. "The Measurement of Particle Sizes and their Distribution in the Condensation Nuclei Counter," Cole, C. J., et al, Cambridge Technology, Inc., Newton Upper Falls, Massachusetts, Report 5023-2, November 1969.

Synopsis: Report covers aerosols, sampling, electrostatic precipitators, and particle size distributions.

Health Effects

1. "Current Problems of Toxicology: Mutual Relationships Between Chemical Toxicology and Medical Toxicology," Lohs, Karl-Heinz, Army Foreign Science and Technology Center, Charlottesville, Virginia, Report No. FSTC-HT-23-1421-72, January 1973.

Synopsis: Chemico-clinical observation of operating personnel.

2. "Inhalation Toxicology Research Institute, Annual Report, October 1972 - September 1973," McClellan, R. O. and Rupprecht, C., Lovelace Foundation for Medical Education and Research, Albuquerque, New Mexico, LF-46, Contract AT-29-2-1013, December 1973.

3. "USAEC Division of Biomedical and Environmental Research, Annual Report, 1973, PT. 02. Ecological Sciences," Vaughan, Burton E., Pacific Northwest Laboratories, Richland, Washington, BNWL-1850, January 1974.

4. "Proceedings of 6th Berkeley Symposium on Mathematical Statistics and Probability, Vol. VI, Effects on Pollution on Health," University of California Press, 1972.

5. "Studies Concerning Aerosol Deposition in the Respiratory System," Kimura, L., Kanner (Leo) Associates, Redwood City, California, NASW-2481, March 1973.

6. "Biological Effects of Inhalation of Aerosolized Pollutants Found in Lunar Soils," Kenyon, A. J., Connecticut University, NASA-CR-128560, September 1972.

7. "Effect of Nitrogen Dioxide on Aerosols of Serratia Marcescens, Flavobacterium, Bacillus Subtilis Var. Niger Test Reports," Ehrlich, R. and Miller S., IITRI-L6032-TR-38, IITRI-L6032-TR-39, IIT Research Insitute, Chicago, Illinois, January 1972.

8. "Effects of Artificial Aerosols; Methods of Synthesis and Analysis of Submicron Aerosols," Goetz, A. and Kallai, T., Army Biological Laboratory, Fort Detrick, Maryland Translation 789, May 1963.

Synopsis: This short report concerns aerosols, hydrocarbons and quantitative analysis of air pollution.

Air-Solid Waste Pollution Technology

1. "The Thermal Destructor, A Facility for Incineration of Chlorinated Hydrocarbons," Montgomery, W. L., et al; Defense Research Establishment, Suffield, Ralston (Alberta), Report No. DRES-270, October 1971.

   Synopsis: Following the Federal Government's decision to ban general use of DDT in Canada, many government agencies were left with stocks of surplus DDT formulations. In order to dispose of these, the Defense Research Establishment, Suffield, built an incinerator specifically designed to decompose chlorinated hydrocarbons. This paper describes the background history and design of this incinerator facility and outlines its construction and operation. It includes a report on the results of the first two months' operating experience, and discusses future plans for destruction of unwanted chemicals.

2. "Classified Materials Incineration: The Problems and Current Approaches to Their Solution," Watson, William W., Naval Civil Engineering Laboratory, Port Hueneme, California, Report No. NCEL-TN-1200, April 1972.

   Synopsis: The Naval shore establishment has found it increasingly difficult to effectively and economically destroy the never-ending accumulation of classified materials generated by modern government. This difficulty has, in addition, been magnified in recent years by the necessity for compliance with increasingly stringent air pollution control regulations. A continuing investigation has been conducted into improved methods for classified materials destruction, with special emphasis on incineration processes. As a result of this program, it has been determined that the "starved air" incinerator is currently a relatively inexpensive and potentially effective unit. For major installations, and for the destruction of large quantities of densely packed or bound material, the "rotating combustion chamber" incinerator appears promising.

3. "Evaluation of Jered "Vacu-Burn" Sanitary Sewage Treatment System," Raupuk, Milton W., Naval Ship Research and Development Center, Annapolis, Maryland, Report No. NSRDC-28-612, May 1973.

   Synopsis: The 200-man Vacu-Burn Sewage Treatment System, installed at the Naval Station Marine Barracks, Annapolis, Maryland, is a no-liquid discharge vacuum-collection system with vortex incineration.

4. "Laboratory Studies of Batch Wet Air Oxidation of Sewage," Naval Ship Research and Development Laboratory, Annapolis, Maryland, Report No. NSRDL/A-28-150, March 1972.

Synopsis: Batch-type wet air oxidation experiments have been carried out on a laboratory scale on samples of domestic waste-water sludges diluted to shipboard sanitary waste concentrations. An 85 percent reduction of chemical oxygen demand (COD) was obtained at conditions of 500-600 F at 1800 to 2250 psi on a one liter chemical autoclave (with stirring at constant speed and in the presence of excess air).

5. "Polar Sanitation - Incineration for Waste Disposal in a Pollution Control System," Drobny, Neil L., Naval Civil Engineering Laboratory, Port Hueneme, California, NCEL-TN-880, March 1967.

Synopsis: It is concluded that incineration provides the most suitable method for disposal of polar camp wastes.

6. "Film Destruction and Silver Recovery," Ristau, William T., New Mexico University, Albuquerque, TR-73-176, December 1973.

Synopsis: A calcinator model 10-GSX incinerator was evaluated for destruction of photographic film and silver recovery. Emissions from the stack were measured during the normal operating mode as well as during a water-spray treatment in the primary chamber to reduce the temperature. The calcinator did not meet the 1972 federal emission standards for particulates.

7. "Evaluation Program for Radioactive Waste Incineration," Lachapelle, David G., Army Nuclear Defense Laboratory, Edgewood Arsenal, Maryland, NDL-TM-24, October 1965.

Synopsis: A 50 lb/hr incinerator and associated gas-cleaning equipment for the concentration of low-level radioactive waste is described.

8. "Study of Concepts and Equipment Suitable for OnBoard Pyrolytic Reduction of Shipboard Wastes," White, R. H., New York Ocean Science Laboratory, Montauk, 1973.

Synopsis: The objective of this study was to evaluate the design, performance, and operational characteristics of the partial and total gasification pyrolysis of organic wastes by direct exposure to hot inert gases, or by fluidized bed pyrolyzers.

9. "Predicting Combustion Products for Disposal of Organic Compounds," Hill, G. A., Defense Research Establishment, Suffield, Ralston (Alberta), DRES-MEMO-41/72, March 1973.

Synopsis: A computer program applying kinetics and thermodynamics was developed to evaluate the quantity and type of combustion products for burning a wide range of organic wastes. As examples, results for DDT and BIS were determined.

10. "New Techniques for Processing of Municipal Refuse," Rothman, Torsten, Air Force Weapons Laboratory, Kirtland Air Force Base, New Mexico, AFWL-TR-71-41, April 1971.

Synopsis: New methods were investigated for processing and disposal of municipal refuse. Volume reduction techniques including incineration and several variations, pyrolysis, compaction, and grinding are discussed in detail. Resource recovery and storage, collection and transportation are also covered.

11. "Preliminary Air Pollution Engineering Survey No. 21-004-71, Edgewood Arsenal, Edgewood Arsenal, Maryland, 14-16 September 1970," Majewski, Robert V., Army Environmental Hygiene Agency, Edgewood Arsenal, Maryland, USAEHA-Survey-21-004-71, September 1970.

Synopsis: A preliminary air pollution engineering survey was conducted at Edgewood Arsenal, Maryland to investigate potential air pollution sources, evaluate the existing 5-year plan for air pollution abatement, and recommend corrective measures combustion facilities, volatile fuel storage facilities, solid waste disposal, hazardous material disposal, and industrial operation.

12. "Incineration of Selected Industrial Wastes," Hirota, Dennis I., Air Force Weapons Laboratory, Kirtland Air Force Base, New Mexico, AFWL-TR-70-173, January 1971.

Synopsis: A preliminary investigation is presented of direct liquid injection incineration as a waste treatment technique.

13. "Design Guide for Explosive Contaminated Inert Waste Incineration," Santos, Joseph, et al, Ammann and Whitney, New York, TR-4586, November 1973.

Synopsis: This report contains guidelines to be used in the development of design criteria for new explosive contaminated inert waste incineration facilities. Also included is a description of the existing facility at Joliet AAP. The facility concept includes facility capacities for incinerating 5,000, 13,000 and 26,000 pounds per day of explosive contaminated inert waste.

14. "Parameters of Shipboard Waste Incineration," Adema, Carl M., Naval Ship Research and Development Center, Annapolis, Maryland, NSRDC-28-774, November 1973.

Synopsis: The combined shipboard waste stream is over 90% water. The combined waste stream cannot be incinerated autogenically with conventional incineration systems. Efficient operation and a highly aqueous waste stream require the design of an incineration with the ability to absorb and release large amounts of heat energy. Incineration systems which are efficient, reliable, and produce a minimum of pollution can be designed. Current efforts involve research and development in incineration and the evaluation of commercially available incinerators.

15. "Review of Leaching Test Methods and the Leachability of Various Solid Media Containing Radioactive Wastes," Wendel, J. E., Pacific Northwest Laboratories, Richland, Washington, Contract AT-45-1-1830, July 1973.

16. "Critical Review of Solid Radioactive Waste Practices at Nuclear Power Plants," Kibbey, A. H. and Godbee, H. W., Oak Ridge National Laboratory, Tennessee, ORNL-4924, March 1974.

17. "Proceedings of Meeting on Environmental Pollution (2nd) 24-25 March 1971," Sponsored by American Ordnance Association, Love, Solomon, Edgewood Arsenal, Maryland EA-SP-100-102, August 1971.

Synopsis: The titles of the reports presented include: Handling and Incineration of Pesticides, Plastics, and Hazardous Chemicals; Advanced Fluid Bed Incinerator.

Air-Water Pollution Technology

1. "Explosives and the Environment," Naval Ammunition Depot, Crane, Indiana, Report No. QEEL/C-73-217, June 1973.

   Synopsis: This report relates the studies that the Naval Ammunition Depot at Crane, Indiana, is prepared to do and those they have done in relation to air, water and environmental pollution. Crane is one of the sites for the Navy Environmental Protection Data Base Project. The emphasis in the report is on TNT.

2. "Ottofuel II: Evaporation Into Air and Diffusion Into Sea Water," Cox, Walter G., et al, Naval Underwater Systems Center, Newport, Rhode Island, Report No. NUSC-TR-4420, June 1973.

   Synopsis: The evaporation rate of Ottofuel II at 25-27 C was determined by weight loss measurements in a nitrogen atmosphere using a new technique based on differential pulse polarography.

3. "Preliminary Evaluation of Disposal Methods and Shipboard Constraints," Demattio, James R., et al, Vitro Laboratories, Silver Spring, Maryland, Report No. VL-C-29598, May 1973.

   Synopsis: Covers the identification of the most cost effective method for handling, processing, and disposal of solid refuse and industrial and chemical wastes for each of the 17 ship classes examined.

4. "Phase II of Phossy Water Aeration Spray Testing at Pine Bluff Arsenal," Brooks, Alan E., Edgewood Arsenal, Maryland, Report No. EA-TR-4707, March 1973.

   Synopsis: The White Phosphorus-Filling Facility, Pine Bluff Arsenal (PBA), Pine Bluff, Arkansas discharges a liquid effluent contaminated with elemental phosphorus and phosphates, as a possible pollution-abatement method, a program of aeration spraying in an open field was proposed to oxidize elemental phosphorus to phosphates and then have the phosphates absorbed by the soil. The purpose of Phase II was to study the long-range effects of phossy water aeration spraying over a 1-year period on a pilot scale. The test apparatus consisted of a crushed-limestone trickle filter and four irrigation spray nozzles. Water samples were analyzed for elemental phosphorus and phosphates; soil samples were analyzed for phosphorus, PH, potassium and sodium (used in PH control of phossy water).

5. "Properties of GB in Water," J. Epstein, Edgewood Arsenal, in Journal American Water Works Association, Vol. 66, No. 1, January 1974.

6. "Use of Evaporation for the Treatment of Liquids in the Nuclear Industry," Godbee, H. W., Oak Ridge National Laboratory, Tennessee, Godbee, H. W., ORNL-4790, September 1973.

7. "New Method of Controlling Radioactivity in Laboratory Waste Water," Eno, Eugene, University of California, Lawrence Berkeley Laboratory, Berkeley, California Univ-LBL-998, April 1972.

8. "Study of Beach Ground Water Hydrology and Chemistry," Dominick, Thomas F., Louisiana State University, Baton Rouge, Coastal Studies Institute, LSU-CSI-TR-152, Contract N-00014-60-A-0211, November 1973.

9. "A Simplified Method for Calculating Ground Contamination Densities From Aerial Spray of Nonvolatile Liquids," Monoghan, J., McPherson, W. R., Defense Research Establishment, Suffield, Ralston (Alberta), DRES-TN-314, March 1972.

10. "Environmental Aspects of Cooling Tower Operation, Survey of the Emission, Transport, and Deposition of Drift from the K-31 and K-33 Cooling Towers at ORGDP," Jallouk, P. A., Oak Ridge Gaseous Diffusion Plant, Tennessee, OPGDP-K-1859, February 1974.

11. "Design Analysis of an Air Force Environmental Pollution Field Laboratory" by Carlton, H. E., et al, Air Force Weapons Laboratory Report TR 73-103, June 1973.

Synopsis: This report contains Air Force requirements for Mobile Field Laboratories involved with air pollution and water pollution. Although not a major portion of the report, part of it does deal with pollution and stack gases.

12. "Characterization of the Naturally Occurring Particulates in the Marine Atmosphere, Trial One Data Summary," Hereim, A. T. and Harris, G. J., Deseret Test Center, Fort Douglas, Utah, DTC-DR-70-00C, January 1973.

Miscellaneous

1. "Soviet Environmental Pollution Control Technology (U)," Central Intelligence Agency Report OSI-STIR/73-5, July 1973, CONF.

2. "Military Research and Development on High Energy Materials: Explosives and Detonation (U)" by Walker, Raymond, R., Picatinny Arsenal, Dover, New Jersey, Report No. PA-TR-4391, April 1972, CONF.

3. "Investigation of Olfactory Techniques in Chemical Air Reconnaissance (U)" by Cavanagh, L. A., et al, Wright-Patterson Air Force Base, Dayton, Ohio, Air Force Avionics Laboratory Report SRI-6-0512, 16 May 1966, SECRET.

4. "Studies of Atmospheric Processes," Fisher, E. R., Air Force Cambridge Research Laboratory, Report No. 730287, December 1972.

5. "Concept Definition of the Navy Environmental Protection Data Base (NEPDB) System," Berg, David N., Stanford Research Institute, Menlo Park, California, Report 26, August 1972.

Synopsis: This report analyzes user requirements for environmental data and develops characterizations of data base components. Preliminary concepts for data base organization and indexing are discussed, and a number of required data files are identified. The functions that the system must perform are discussed and shown in flow charts and more detailed signal flow diagrams. Major alternative system operations discussed are: centralized/decentralized operations, manual/automatic operations, and index and storage media. Trade-off analyses of these alternatives are made and evaluated according to specific criteria. The results of these evaluations are then used to synthesize a set of final NEPDB system options.

6. "Design Analysis of an Air Force Environmental Pollution Field Laboratory," Carlton, H. F., et al, Battelle Columbus Laboratories, Ohio, Technical Report 24, June 1973.

7. "Report on U. S. Navy Environmental Protection Program," Kalinsky, J. L., Naval Material Command, Washington, D.C., August 1970.

Synopsis: This report defines the environmental protection problems of the U. S. Navy, ashore and afloat, and sets forth meaningful RDT&E requirements for each pollution problem area. Existing

state-of-the-art approaches and technology are described and a technical appraisal is rendered for short range and long range solutions. Major Navy problems considered are: shipboard sanitary waste treatment and disposal systems; oil pollution of water resulting from pumping of bilges, deballasting of fuel or cargo oil tanks, aircraft engine exhaust emissions and noise; and ordnance material (explosive, propellants, pyrotechnics, and otto fuel) reprocessing and reclamation.

8. "Environmental Pollution," Koon, C. Doyle, Air War College, Maxwell Air Force Base, Alabama, Report No. 3856, 1971.

Synopsis: Problems now existing and some of the solutions in eradicating them are outlined herein and discussed.

9. "Preliminary Air Pollution Engineering Survey, Pueblo Army Depot, Pueblo, Colorado, 10-11 August 1970," Leininger, K. V. and Ports, K. N., Army Environment Hygiene Agency, Edgewood Arsenal, Maryland, USAEHA-SURVEY-21-002-71, October 1970.

10. "Methods for the Performance Estimation and Design of Nozzles Used to Provide Dusty, Hypersonic Flow Environments, Final Report, 1 April to 16 September 1971," Lewis, H. F., Aro, Inc., Arnold Air Force Station, Tennessee, ARO-PWT-TR-71-206, December 1970.

11. "Selected Research and Development Projects in Environmental Quality," M. Dobbs, et al, Air Force Weapons Laboratory, Kirtland Air Force Base Tech Note AFWL-DE-TN-74-005, March 1974.

12. "Reference Book on Chemical Warfare, (U)" Army Material Command, ST-HB-03-18-17, 20 September 1972, SECRET.

13. "High Altitude Release, (U)" J. Morrison, DTC 72-1389, Deseret Test Center, August 1972, SECRET.

14. "Study of the Electrostatic Field and Charge Distribution in a Vortex Seeded with Dust," Daugherty, John W., and Velkoff, Henry R., Ohio State University, Columbus, Contract DA-31-124-ARO-D-246, July 1973.

15. "Mechanics of Dust Erosion, Monthly Progress Report 12 July 1973," Miller, R. J., McDonnell Douglas Astronautics Company, Huntington Beach, California, Western Division, Contract DNA-001-72-C-0204, August 1973.

16. "Literature Review on Turbine Combustor Modelling and Emissions, July 1972 - March 1973," Osgerby, I. T., Arnold Engineering Development Center, Arnold Air Force Station, Tennessee, AEDC-TR-73-163, November 1973.

17. "Environmental Impact of B-1 Emissions in the Stratosphere," Stergis, C. G., Air Force Cambridge Research Laboratories, L. G. Hanscom Field, Massachusetts, AFCRL-73-0608, October 1973.

18. "Use of an Air Assisted Fuel Nozzle to Reduce Idle Emissions of JT8D Engine Combustor," Papathakos, Leonidas C. and Jones, Robert E., National Aeronautics and Space Administration, Cleveland, Ohio, Lewis Research Center, NASA-TM-X-2946, November 1973.

19. "Radiological and Environmental Research Division Annual Report, July 1972 - June 1973, PT. 02.," Argonne National Laboratory, Illinois, ANL-8060, June 1973.

20. "One Dimensional Model of the Movement of Trace Radioactive Solute Through Soil Columns, the Percol Model," Routson, R. C. and Serne, R. J., Pacific Northwest Laboratories, Richland, Washington, BNWL-1718, 1972.

21. "Atmospheric Pollution by Aircraft Engines," Advisory Group for Aerospace Research and Development, Paris, France, AGARD-CP-125, September 1973.

22. "Analytical Analysis of the Dispersion Predictions for Effluents from the Saturn 05 and Scout ALGOL 03 Rocket Exhausts," Stephens, J. Briscoe, National Aeronautics and Space Administration, George C. Marshall Space Flight Center, Alabama, NASA-TM-X-2935, October 1973.

23. "Initial Dust Lofting, Shock Tube Experiments, Final Report," Ausherman, Darrell R., TRW, Inc., Redondo Beach, California, Contract DNA-001-72-C-0120, TRW-21830-6003-RU-00, September 1973.

24. "Isotropic Theory for Dewettable Solids," Lindsey, G. H. and Wood J. E., Naval Postgraduate School, Monterey, California, NSP-57-LI-71011-A, January 1971.

25. "Numerical Methods for Fluid Dynamics, an Annotated Bibliography," Harlow, Francis, H., Los Alamos Scientific Laboratory, New Mexico, LA-4281, September 1969.

26. "Environmental Impact Statement Conference, Proceedings, 03/2 September 1972 - 30 March 1973," Department of the Navy, Washington, D.C., March 1973.

27. "Atmospheric Pollution by Aircraft Engines, Technical Evaluation Report on Agard Technical Meeting," Libby, Paul A., California University, San Diego, AGARD-AR-63, November 1973.

28. "Use of Ion Exchange for the Treatment of Liquids in Nuclear Power Plants," Lin, K. H., Oak Ridge National Laboratory, Tennessee, ORNL-4792, December 1973.

29. "Concept Definition of the Navy Environmental Protection Data Base System, Phase 01, Final Report, May 1972 - June 1972, PT. 01, Technical Studies and Conclusions," Collins, Harold B., Jr., General Electric Company, Philadelphia, Pennsylvania, GE-CR-73.005, Contract N-62399-72-C-0007, June 1972.

Synopsis: This study was to define concepts for the Navy Environmental Protection Data Base (NEPDB) system. The conceptual designs are derived from user requirements and Naval instructions and are described in terms of functional relationships and signal flows. The results are justified by appropriate trade-offs and cost estimates.

30. "Concept Definition of the Navy Environmental Protection Data Base-NEPOB-System, Final Report, April 1972 - August 1972," Beckers, Charles V., Raytheon Company, Portsmouth, Rhode Island, RAYTHEON-R-1214, Contract N-62399-72-C-0008, August 1972.

31. "Soil Moisture Transport in Arid Site Vadose Zones," Isaacson, R. E., Atlantic Richfield Hanford Company, Richland, Washington, ARH-SA-169, Contract AT-45-1-2130, January 1974.

32 "Evaluation Statements and Abstracts of Recent Acquisitions On Soil Mechanics and Related Subjects, List 25," Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, February 1974.

33. "Naval Ship Systems," Air Contaminant Control and Environmental Data Base, Naval Ship Research and Development Center, 28-443, November 1972.

34. "Studies of Air Pollution from a Land Based Steam Generator," Naval Ship Research and Development Center, 28-744, November 1973.

35. "Evaluation of Developed Methodology for Shipboard Steam Generator Systems," Naval Ship Research and Development Center, March 1973.

36. "Microstructures and Area Contamination Profiles of Aitken Type Condensation Nuclei Clouds from Small Sources," H. T. Reilly, Army Land Warfare Laboratory, Aberdeen Proving Ground, Maryland.

37. "Materials for Wet Oxidation Processing Equipment," National Materials Advisory Board, NMAB-312, December 1973.

Appendix C

Laboratory Capabilities and Contacts

Air Force

Army

Navy

AEC

AIR FORCE WEAPONS LAB

1. The visit to AFWL was concerned with their Environics Branch. Within this branch are air, solid, and water sections and the ecosystems technology section.

2. Major emphasis in the branch is on pollution control engineering and disposal technology.

3. The Air Resources Section is investigating procedures to control or eliminate identified sources of air pollution in the Air Force. Efforts for establishing standards for evaluating pollution sources and for developing technology to control the pollution are being coordinated with the USAF Environmental Health Laboratories.

4. Representative projects at AFWL include:

   a. Air Force pollution emission factors.

   b. Smoke abatement system for crash/rescue training fires.

   c. Combustion-incineration products of plastics and films.

   d. Smoke abatement methods for jet engine test cells.

   e. Film destruction/silver recovery.

5. One of the efforts at AFWL concerns the AQAM (Air Quality Assessment Model). This model, supposedly an amalgam of the best parts of the EPA AQDM and Dugway geometric model plus new concepts, ranks with the EPA, Argonne, and Army Natick Lab models for airports. The AQAM output provides contour plots of pollution.

6. AFWL also has an operational mobile air pollution monitoring van.

7. Major Don Silva is the point of contact, (505) 247-1711, X2050.

EDGEWOOD ARSENAL

8. Edgewood Arsenal is the largest center of chemical research and development within the Department of Defense. It is an installation consisting of 10,000 acres of land and about 5.5 million square feet of building space.

9. Edgewood's current mission to detect, identify, and measure trace quantities of contaminants in air, food, soil, tissues and on all types of surfaces is directly applicable to environmental studies. Currently, Edgewood is the Army Material Command's lead lab for Pollution Abatement and Environmental Control. Also, Edgewood is involved in studies to determine how the pollutants are transmitted through the eco-chain to man.

10. Environmental pollution control is a major function at Edgewood. In addition to extensive facilities and expertise in water and solid waste problems (air will be discussed at length, presently), Edgewood is involved in interface areas, such as the incineration of hazardous liquid wastes and its impact on air pollution. The effects of pesticides on the environment is also an area of expertise for Edgewood.

11. Edgewood has the capability to design and develop instrumentation for environmental monitoring. Research into the application of chemical agent detectors and alarms for detection of air and water pollutants is underway, as are projects concerned with gas and aerosol cloud meteorology and micrometeorology.

12. An extensive capability in veterinary medicine is available at Edgewood for the purpose (among others) of establishing the effects of environmental pollutants on living systems.

13. A considerable body of knowledge and unique experience is available in the design of specialized filters for the removal of gross and trace quantities of vapors and aerosols. This includes the development of specialized test techniques to evaluate the performance of filters. Leakage determination can be made in the parts-per-billion (ppb) range for aerosols, and near the nanogram per liter range for vaporous contaminants. Special filters and mountings can be designed for virtually any application and capacity desired.

14. Other methods of air purification than mechanical filtration and sorption have been investigated at Edgewood, including electrostatic precipitators for particulates and thermal and wet scrubbing techniques for vapor contaminants. Extensive studies in fibrous roughing filters and bag filters have also been performed for aerosol and dust removal.

15. Edgewood has developed and evaluated data which have resulted in mathematical models of atmospheric behavior. The models take into account the nature of the source (geometry, time of release, etc.), the nature of the pollutant released and predict the resulting space and time variations in concentration. These models form the basis for predicting the hazard from potential pollution sources. Analysis of the predicted behavior of potential or existing pollution sources will indicate the extent of the hazard and the degree of air pollution control which will be required to correct the problem. Edgewood studies of atmospheric behavior chemical agent deployment are directly applicable to the transport diffusion, fallout, interception and sorption of air pollutants in the environment.

16. This capability in aerodynamic investigations extends to subsequent effects on the ecological system and includes solid, liquid and gaseous states.

17. An extensive computer facility is necessary to support the above model. The 1108 is available to EPA as well as such services as the automatic calculations of volumes, surfaces, centroids, and other assorted shapes. Uses of this service can include calculating mapped areas for ecological studies and analyzing spectral data for atmospheric pollutants.

18. Other facilities and capabilities at Edgewood include:

a. Active and Passive LOPAIR (Long Path Infrared) detectors.

b. Remote Raman Chemical Detectors.

c. CO_2 Laser Chemical Vapor Detector.

d. Chemical Detectors and Alarms.

e. Enzyme Chemical Detector and Alarm.

f. Flourescent Pollutants Detector Kit.

g. Arsenicals in Water Sampler.

h. Chemical Samplers.

i. Ionization Detectors.

j. Chemical Vapor Concentrator.

19. Passive LOPAIR study models indicate that low angle sky infrared energy can be used to detect and monitor the intervening path for the presence of pollutants. Similarly, the CO_2 laser LOPAIR may be useful for remote low angle sensing of impurities.

20. The remote Raman System also offers promise for the remote sensing and monitoring of atmospheric pollutants.

21. Extensive reference files of infrared, ultraviolet, Raman, laser Raman, visible, atomic absorption, emission and mass spectra have been accumulated at Edgewood.

22. Edgewood's analytical chemistry effort is aimed at developing methods for qualitative and quantitative analysis in the parts-per-billion area and ranging up to tons. A number of advances in high volume sampling have been made for monitoring extremely low concentrations of air pollutants and chemical agents. Devices have been designed and tested for collection efficiency at sampling flow rates up to 200 liters per minute. One device, based on the venturi principle, shows a collection efficiency greater than 75% at 100 liters per minute. Air concentrations of chemical agents in the order of .0003 mg/m^3 can be determined within five minutes, continuously and automatically. The venturi scrubbers device can be used for monitoring stack emissions.

23. Twenty-three exposure chambers, two wind tunnels, aquaria, and climatic facilities to produce any global condition give Edgewood the capability to sample, analyze, characterize, and evaluate the hazard resulting from virtually any industrial chemical, waste product(s), or natural products. In addition to a large low velocity wind tunnel capable of holding several people, Edgewood has a subsonic wind tunnel, 14 by 20 inches, with a test section three feet in length, and a 14 by 20-inch cross section, capable of speeds from 15-300 miles per hour. Also, a subsonic wind tunnel, 28 by 40 inches, with an open circuit straight settling chamber tunnel, capable of speeds from 25-160 miles per hour.

24. The types of field instrumentation developed at Edgewood Arsenal are directly applicable to continuous use as environmental monitoring systems since they give immediate read-outs of the results. An outdoor, instrumented test range with concentric sampling grids is available for monitoring airborne pollutants.

25. Work has been done at Edgewood on the destruction of chemicals by incineration. This was accomplished by actual burning of toxic chemicals in a pilot scale incinerator with complete collection and identification of the stack emissions.

26. Contacts at Edgewood include:

Dr. John Stevens, overall: (301) 671-3133
Dr. L. A. Jonas, Chemistry: (301) 671-3753
Dr. Ira Abelow, Scrubbers, Particulate collection, Asbestos detection: (301) 671-4251
Dr. S. Love, Ionization detection, Real time monitoring: (301) 671-3971
Dr. B. P. McNamara, Low velocity, Wind tunnels, Aerosol generation: (301) 671-3034

ARMY LAND WARFARE LAB

27. As this report goes to press, LWL is in the final stages of phase-out. Equipment obtained from LWL is described elsewhere in the Interim Report; LWL capability has been scattered, but remnants of it have been absorbed by other agencies such as Edgewood Arsenal. Strongest capabilities were in remote IR sensing of particulates (transferred in essence to Edgewood) and real time mass spectrometer techniques.

ARMY WHITE SANDS MISSILE RANGE

28. Several projects and technologies pertinent to EPA requirements are available at White Sands, including:

a. Particulate characterization (down to less than .05μ).

b. Aerosol generation.

c. IR spectrometry.

d. Dust sampling (world wide).

e. Optical degradation due to pollutants.

f. Nephalometry.

g. Chemical analysis (wet).

29. Work at White Sands in these areas has not had the visibility that related work at DOD labs has had; nonetheless, it appears to be high quality.

30. The central point of contact in the Atmospheric Sciences Laboratory is Glenn Hoidell, (915) 678-2926.

DUGWAY PROVING GROUNDS

31. Dugway capability is in the area of environment control. Specifically, the generation, measurement, tracking, collection and analysis of fine particulate aerosols in low concentrations over long distances constitute a significant effort at Dugway.

32. For the past two decades Dugway has conducted extensive studies in identifying, measuring and monitoring chemical and biological materials in the atmosphere and developing mathematical techniques to characterize their transport and diffusion in these media. Field studies have been conducted at remote locations throughout the world to extend knowledge of airborne material behavior in a variety of meteorological regimes.

33. Specifically, the technologies and capabilities possessed by Dugway in these areas include:

a. Development of analytical techniques for pesticides or process waste components.

b. Development of instrumentation to measure trace contaminants from mixed waste streams.

c. Biological research of processes utilizing living organisms and their by-products.

d. Sampling and analysis of particulate and aerosol clouds.

e. Tracer studies to characterize an emission source including the development of diffusion and transportation models to define their travel.

f. Conduct of ecological field studies to define the effects on the total environment as a result of a specified operation.

g. Conduct of field studies requiring large numbers of remotely controlled samplers followed by automated processing of large numbers of resulting samples for analysis.

h. Tests of objects or devices under a wide variety of programmable controlled environmental conditions.

i. Tests requiring a complete integrated facility to be established on site (characterization of a pollution source, utilizing tracers and requiring extensive field sampling and sophisticated meteorological field measurements).

j. Particle generation (1-5μ).

k. Bio-denitrification using anerobic bacteria.

l. Waste water treatment.

m. Stack monitoring.

n. Marine aerosol particulates research.

o. Spray systems evaluation.

34. An extremely broad system of facilities is necessary to support the broad spectrum of capabilities exhibited by DPG. The following is a partial compilation of pollution related facilities:

a. Chambers

(1) Over 20 chambers of various sizes up to 50' x 30' x 20' are available, with a capability for a wide range of programmable environmental conditions from arctic to desert, tropic to cold, salt fog to rain, and low pressures to sand and dust.

b. Filter Tests

(1) Two penetrometers are maintained for the purpose of measuring the penetration and life of filters. The penetration is measured by passing 0.3 micron smoke through and measuring the degree of penetration.

c. Atomic Absorption Spectrophotometer

(1) The Model P-E 303 is an analytical flame instrument which is used to determine the trace metal content of a sample. This technique appears to be the most reliable and rapid means for detecting and analyzing metals.

d. Robot Chemist Analyzers

(1) This instrumentation is used for colorimetric/spectrophotometric analyses for which time and/or temperature control is critical. Its main use is in the analysis of trace quantities of chemicals. For example, methyl acetoacetate may be analyzed over the range 0 to 1 mmg/ml, with a lower detection limit of less than 0.1 mmg/ml. Because of the time and temperature controls, this instrumentation is ideally suited to the enzymatic assay of trace quantities of some chemicals down to less than 0.001 mmg/ml.

e. Sampling Hardware

(1) Over 8,000 samplers of various types include large numbers of all the conventional samplers such as all glass impingers (AGI's), Anderson particle size discriminating samplers, Reynier slit samplers, Rotorod fluorescent particle samplers, Millepore filter samplers, chemical bubblers, chemical impactors, Snoot filter samplers, Cascade Impactor samplers, and filter paper and printflex card samplers. Various combinations of sampling sequencing are accomplished by using such units as the radio-controlled biological and chemical sampler (B-C Unit) and the M-37 wire-controlled sampler. For special testing, the Large Volume Air Sampler (LVAS) is used. A limited number of more specialized samplers used at DPG include the Microaerofluorometers (MAF's), Royco particle counter, and Space Charge Atmospheric Precipitator (SCAP). Quantitative vapor and droplet data can be obtained on particle sizes below 5 microns and above 100 microns. Mass quantity can be determined for the intermediate size range. Particulate matter in the size range of 0.5 microns to 15 microns has been the range of interest in DPG testing, hence expertise and capability are concentrated in this area.

f. Automatic Data Acquisition System (ADAS)

(1) DPG has two ADAS each of which consists of a data central collection terminal housed in an air transportable mobile van. Each van can control up to 24 low data rate remote stations and 12 high data rate remote stations. Data is telemetered from the remote stations via simplex RF links to the central terminal. Each remote station can handle up to 64 sensors, 24 of which can be sampled at the rate of 10 times per second and the remaining 40 at the rate of once per second. Data is telemetered from the remote station via simplex RF links to the central terminal.

g. Meteorological Facilities

(1) DPG has extensive meteorological facilities for the measurement and display of weather phenomena on the micro scale or the macro scale. Meterological tests are performed to develop and/or prove model theory and to support testing.

(2) A USAF-operated weather station is located at DPG. This facility serves as an important element of weather services coverage in the Western United States. Facilities associated with this service include an FPS-77 weather radar, a direct line radar facsimile to the U. S. Weather Bureau in Salt Lake City, a Rawinsonde facility, and a national weather facsimile and teletype system.

(3) By mutual arrangements with the U. S. Weather Bureau (ESSA) and the FAA, the DPG system is combined with the ARTC radar network in a weather surveillance program which provides weather radar coverage for the Western United States. The product is a composite summary of precipitation echoes from up to 22 radar stations in the Western United States. This product is transmitted hourly, on the hour, only 15 minutes after the time of observation. The transmitted chart gives location, type of precipitation (snow, rain, thunderstorms, etc.), and an estimate of the intensity of the precipitation (this includes direction and speed of movement of the precipitation echoes). These charts are exchanged on a hot-line facsimile circuit between Salt Lake City, FAA facilities, and DPG. In addition to this system of filling the gaps to extend effective radar coverage of the FPS-77 radar at DPG, operators can communicate directly for additional information concerning specific echoes so as to enhance this capability.

(4) The combined DPG meteorological data systems (in terms of the total number of meteorological sensors), the area covered by the sensor networks, and the total data acquisition and processing capabilities comprise the largest automated fixed point system in the United States.

h. Life Sciences Laboratories

(1) The Life Sciences Laboratories encompass a broad spectrum of activities in biology, microbiology, biochemistry, toxicology, and fluorescent tracers. Its physical facilities include research laboratories, laboratories designed for the support of field testing, ecology, epidemiology and toxicology, breeding and rearing units for small laboratory animals and for selected species of native fauna. Also, the facilities serve as holding units for small and large experimental animals including cattle and horses.

(2) The capabilities are characterized by mobility since they were developed not only for testing at Dugway but also for operations at distant sites. Moreover, they are also well-suited to various nonmilitary applications such as studies of the effects of environmental pollution in air, soil, and water (and steps required

for pollution abatement); investigations in the general area of medical microbiology and medical aerobiology; research in the toxicology of pesticides; meteorological studies and tracing of the movements of masses of water through the ability to select, sample, and assay suitable physical tracers; and for research in mammalian and microbial biochemistry.

(3) Devices in the laboratory permit the generation and holding of confined aerosol clouds under closely controlled conditions and over a wide span of temperatures and humidities. Laboratory studies of samplers, collecting fluids, culture media, and assay techniques can thus be performed with aerosols that are a reasonable approximation of those generated in the field. It is possible to study the effects of environmental conditions on contained aerosols for comparison with changes found in the open air and to conduct animal exposure studies.

(4) Recently, these aerosol facilities have been supplemented by a series of other items designed for specific purposes. Among these are a large-diameter duct for work with dynamic aerosols at ambient temperature and humidity; multi-channel particles size analyzers, a spinning-disc particle generator with static eliminator; submicron aerosol generators; ozone generator and ozone, nitrogen oxide, and sulfur dioxide analyzers, for the study of the effects of air pollutants on the survival of airborne microorganisms. Animal exposure facilities, an integral part of the installation, permit such studies as testing the effect of air pollutants on animals.

(5) A completely new capability, the microthread technique, consists of depositing micron-sized aerosol droplets of biological materials under closely controlled conditions in an enclosure on extremely fine stainless steel wires held on frames. Thereafter, the frames containing the coated wires may be exposed to any desired environmental conditions to study the effect of factors such as air pollutants, relative humidity, temperature, and solar irradiation on the survival of microorganisms. In this way, properties of captive aerosols may be studied outside chambers. The usefulness of this approach may extend to the detection and abatement of air pollution.

(6) Greenhouses are used in toxicological studies involving plants and permit growth of indigenous plants and feed crops throughout the year on a limited scale. Their usefulness in environmental and pollution studies is evident.

(7) Aside from the skill and equipment to perform virtually any type of microbial assay, a complete capability for fluorescent particle tracer work exists; this ranges from evaluation of new and conventional types of phosphors, through evaluation of powder fluidizers, testing and quality control of fluorescent pigments, to the assay of field samples by procedures maintained under tight quality assurance of data. Soluble fluorescent tracers can be assayed with exceptional sensitivity by special methods (in some

cases, at the sensitivity of parts per 10 billion level). Such tracers are useful in a number of ways, for example: (1) to delineate aerosol clouds; (2) to permit elimination of negative sampling stations so as to diminish assay expense; (3) to aid in studies involving determination of biological and physical decay of aerosol clouds; and (4), in meteorological and environmental pollution studies. These substances have been used to study the hazards of secondary aerosols created in biologically-contaminated areas, and they could be used to determine analogous hazards in hospitals. They have recently been applied for testing of the efficacy of particulate filters, and initial work has shown the feasibility of their use in devising appropriate methodology in the use of insecticides in various environments.

(8) The central point of contact at Dugway for these technologies is Mr. Vic Pratt, (801) 789-3531.

NAVAL WEAPONS CENTER

35. Significant capabilities exist at NWC of interest to EPA. These include:

a. Atmospheric and weather modification research.

b. Remote and three-dimensional ambient air quality measurements using airplane and van.

c. Measurements of trace toxics and hazardous materials in water using polarographic techniques.

d. Environmentally-controlled aerosol test chamber for generating aerosols and testing effects of control variables.

36. Apparatus available include a variety of systems for collection, sizing and identification of particles and droplets in the atmosphere, remote optical and electromagnetic sensors for monitoring of such materials, and an extensive array of ground-based and airborne meteorological sensors. Resolution down to 0.046 Å is available. Additional capabilities include:

a. X-ray diffraction techniques for correlating particulate matter to its source.

b. Aerosol generation of metal oxides, sulfides, etc. short term or continuously for up to 16 hours with stable output.

37. Details of these capabilities follow:

a. The Environmental Studies Group uses an instrumented airplane (twin engine Cessna) and a mobile van, both of which continuously monitor various atmospheric parameters and pollutant

concentrations. These parameters are recorded on magnetic tape which is processed on a Univac 1108 computer.

b. More sophisticated data analysis techniques such as X-ray fluorescence, electron microscopy, and atomic absorption will be used in ongoing projects--two of which are a Navy funded Range Visibility Study and an Air Force funded study of solid rocket motor exhaust.

38. The mobile van monitors (continuously):

a. Temperature.

b. Humidity.

c. Wind direction and speed.

d. Visibility (Nephelometric).

e. Ozone concentration.

f. CO concentration.

g. NO or NO_x concentration.

h. Condensation nuclei.

39. The airplane continuously can monitor:

a. Aircraft position (VOR, DME) and altitude.

b. Temperature.

c. Humidity.

d. Turbulence.

e. Visibility (Nephelometric).

f. Ozone concentration.

g. CO concentration.

h. NO or NO_x concentration.

i. Condensation nuclei.

40. The central point of contract for the above efforts is George Linsteadt, (714) 939-7325.

NAVAL CIVIL ENGINEERING LAB

41. In its two environmental protection groups, NCEL has 40 professional engineers and scientists, plus technicians and support personnel. Five specialty teams monitor and analyze noise, source emissions, air quality, land and water pollution, and conduct reconnaissance surveys of Naval activities for pollution sources and intensity. Other areas of environmental expertise include solid and liquid waste disposal, ship sewage transfer, beach oil spill cleanup, oily waste treatment, and environmental data collection, storage and dissemination.

42. On 7 August 1973 the Navy Environmental Protection Data Base (NEPDB) was formally defined. Air monitoring programs will be initiated in FY75 and increased annually toward full monitoring capability in 1978.

43. A return visit to NCEL would be beneficial after significant implementation of air programs has been accomplished.

NAVAL ORDNANCE LAB

44. The primary technology available at NOL in air pollution monitoring and control is in the area of aerosol size distribution determination, although studies of particulate control can also be conducted here.

45. The Laser Doppler Velocimeter (LDV) developed by Dr. W. Yanta (202) 394-2093, can measure distributions in the 0.3 - 5 μ range. The analysis of particulate behavior is primarily a fluid mechanic problem. Theoretical and experimental studies in particulate generation, filtering, and particle mechanics have been conducted at NOL in addition to those involved with the LDV, including:

a. Theoretical studies to determine aerosol-concentration distributions and deposition flux for dilute aerosols suspended within turbulent gas flows. Consideration was devoted to the effects of particle agglomeration and to the influence of electrical forces on the particle deposition behavior.

b. Experimental measurements of gas constituents concentrations by the use of a laser Raman spectroscopy. Experimental investigations of the fluid properties of a high-speed rotational flow have been carried out.

NAVAL RESEARCH LAB

46. In addition to a substantial involvement in water pollution, NRL has the following capabilities:

a. Aerosol generation and filtration (Harold Bogardus).

b. Gas sampling and monitoring (Walter Faust).

c. Micro-particulate sizing and flow (Felix Rosenthal).

d. Sample characterization (cyclotron) (Clarence Bond).

e. Asbestos characterization (Jerome Karle).

f. Sea-air interactions.

g. Effects of pollutants on photosynthesis.

h. Water vapor measurements in the stratosphere.

47. Central point of contact is Robert Seebold, (202) 767-3083.

NAVAL POSTGRADUATE SCHOOL

48. A review of the research programs revealed only one current or recent project relating to air pollution and a final report has not yet been published. This project involved the characterization of air stream patterns for dispersion of aerosols and methods of reducing and controlling pollutant emissions.

49. However, capabilities are strong in the meteorological and computer science areas with an IBM 360-67, low velocity wind tunnels, instrumentation, and lasers. Dr. Haltiner, head of meteorology, is on the Monterey County board for air pollution control. (Navy Weather Central is located at the NPGS).

50. Dr. Gaver, head of the Operations Research Department, suggests a strong capability in dispersion modeling and analytical techniques exists at NPGS.

51. The central point of contact is Dr. James Jolly, (408) 646-2691.

NAVAL MISSILE CENTER

52. Two items of interest are uncovered at NMC:

a. TiO_2 0.55μ particle generator capable of generating pounds per minute.

b. Automobile exhaust scrubber.

53. Negotiations are underway to attempt a transfer of the particle generator to EPA. The auto exhaust scrubber takes the place of the resonator, is made of PVC, outlasts the exhaust system, and only costs about $25.00 to make (by hand). It actually boosts gas mileage (4 to 8 miles per gallon) because it is possible to eliminate the smog pump and some other anti-pollution devices on the car. The only maintenance is replacement of the strainer about every six months. Tests for CO and CO_2 output showed no measurable (on gas station equipment) output. Also, when placed on cars with bad rings, the visible oil smoke in the exhaust is completely eliminated. The inventor of the device is Mr. Everett Rowe, (805) 982-7192.

NAVAL SHIP RESEARCH AND DEVELOPMENT LAB

54. NSRDL is primarily involved in water and solid waste pollution problems. However, some work is on-going in air problems related to particulate emissions and SO_x and NO_x from ship stacks, as well as particulates, CO_x, and aerosols aboard the closed environment of submarines.

55. NSRDL's Pollution Abatement Division consists of approximately 30 people. Major areas and contacts are listed below:

a.	Air Pollution from Navy Ships:	B. Wallace
b.	Air Pollution within Submarines:	J. S. Post
c.	Navy Data Base Programs:	G. B. Nickol
d.	Water Pollution:	J. I. Schwartz
e.	Thermal Pollution:	W. Adamson
f.	Solid Wastes:	P. Schatzberg
g.	Liquid Wastes:	W. VanHees

56. The central point of contact is Mr. Isadore Cook, (301) 227-1852.

NAVAL WEAPONS LAB

57. The Naval Weapons Lab was awarded the task of fabricating a mobile scrubber under IAG 133D. This task is being performed separately from task 1 of the agreement; therefore, it will not be covered here. In addition to their capability in this area, NWL also has an operational silver recovery incinerator.

NAVAL ELECTRONICS LABORATORY

58. NELC is not currently involved in work relating to air, water, or solid waste pollution control, nor was previously developed technology in these areas evident. However, NELC possesses a strong electronic instrumentation capability, therefore, they should be considered as able to provide technology in this field should the need arise.

NAVAL UNDERSEA CENTER

59. NUC is primarily concerned (pollution-wise) with water pollution problems. At the time of the visit the IAG had not been expanded to include the impact on air and water pollution; therefore, a follow-up contact will be made to determine if NUC has technology involving the air-water interface.

LAWRENCE BERKELEY LABORATORY

60. The strongest air pollution technology LBL seems to have is in the area of trace-substance detection and analysis. The technique is good for heavy metal oxides but best for characterizing NO_x, SO_x, etc. A single scan on a 100 nanogram sample will yield sufficient information to determine which heavy metal oxides and pollutants such as NO_2 and SO_3 are present. Also, the technique can identify particles smaller than 100Å. This has importance because, e.g., ultrafine carbon particles apparently catalyze $SO_2 \rightarrow SO_4$. Leasing cost for a new analytical machine is about \$25K/year, plus \$35K/year for personnel. A "leisurely" sample analysis rate yields a gross total cost of about \$60/sample.

61. Other areas of expertise and hardware available at LBL include:

a. X-ray fluorescence.

b. Photoelectron spectroscopy (ESCA).

c. Isotope-zeeman absorption spectroscopy.

d. Resonance-Raman lidar spectroscopy.

e. Laser optoacoustic spectroscopy.

f. Microwave spectroscopy.

g. Mass spectroscopy.

h. Survey of instrumentation for environmental-quality monitoring.

62. California is funding a two dimensional ground level study for particle characterization at LBL (primarily metal compounds).

63. Dr. T. Novakov is head of the trace substance detection and analysis effort on (415) 843-5319.

LOS ALAMOS SCIENTIFIC LABORATORY

64. LASL's Industrial Hygiene Group is involved in air and water pollution areas. Mainly concerned with aerosol R&D, the group possesses capabilities in:

a. Filtration.

b. Resuspension of particulates.

c. Modeling (filter performance, aerosol generation).

d. Multi-stage impactors.

e. Plutonium removal from the air.

f. Biomedical and environmental research in general.

g. Aerosol generation (coal dust, silica, fly ash, asbestos).

65. The central point of contact for these technologies is Mr. Harry Ettinger, (505) 667-5231.